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MILLER'S

BUSINESS ARITHMETIC

AND

Self-Instructor by Cancellation,

WITH EXPLANATORY NOTES.

BY

J. H. MILLER,

Of Cuthbert, Randolph Co., Ga.

CUTHBERT, GEORGIA.

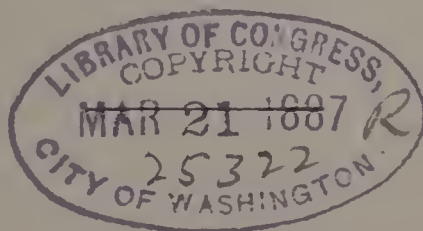
1887.



Very Respectfully
J. W. Miller,

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John BY
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OF CUTHBERT, RANDOLPH COUNTY, GA.



CUTHBERT, GA.
1887.

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PREFACE.

HAVING had eighteen years' experience in traveling, teaching and giving public lectures on the science of numbers, I have obtained many advantages, and in this little work propose giving my fellow-men the benefit of these advantages by presenting a series of rules based on "common-sense" principles and not filled with mathematical brushwood. But to understand and appreciate its merits the student must have a knowledge of the fundamental rules of arithmetic. Brevity in the solution of problems is very essential and necessary and cannot be dispensed with in every-day business, especially in the present fast age.

It will be observed that we use a vertical line "right and left" and abbreviate by "cancellation," which as taught by the arithmeticians of the day is complete, though as presented is somewhat complicated and but the fewest num-

ber adopt it. In the present work we propose to use brevity and simplicity, making the same interesting and pleasant to the pupil. It will be seen that each rule tells what numbers to place on the right and what on the left of this vertical line, and under the rule is a plain "explanatory note" telling the whys, etc.; otherwise it would amount to a mechanical solution of the proposition. Hence fail to give vent to your feelings. Indeed, any rule *not understood* is mechanical. The whole principle, as herein taught, is by proportion, and where there is no proportion there is no mathematics. I dwell, to some extent, on the principle of cause and effect, which is fully explained in my *Common-Sense Arithmetic*, brought out in 1882.

I deem it unnecessary further to preface this little work, and send it out upon its own merits, with the sweet and consoling thought that figures "properly put together" cannot deceive the

AUTHOR.

CUTHBERT, GA., Mar. 1, 1887.

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MILLER'S BUSINESS ARITHMETIC

AND

SELF-INSTRUCTOR.

SIGNS.

THE SIGN OF EQUALITY.—Two short horizontal lines ($=$), read “equal” or “equal to.” Thus, 12 inches $=$ 1 foot.

THE SIGN OF ADDITION.—An erect cross ($+$), read “plus” or “added to.” It denotes that the quantities between which it is placed are to be added together. Thus, $4 + 8$ signifies that 4 is to be added to 8, $= 12$. Placed after an answer, it also shows there is a remainder.

THE SIGN OF SUBTRACTION.—A short horizontal line ($-$), read “minus” or “less.” It denotes that the quantity on the right is to be subtracted from the quantity on the left. Thus, $12 - 4$ signifies that 4 is to be subtracted from 12, $= 8$.

THE SIGN OF MULTIPLICATION.—An in-

clined cross ($\times$), read "times" or "multiplied by." It denotes that the quantities between which it is placed are to be multiplied. Thus, 4×8 signifies that 4 is to be multiplied by 8, $= 32$.

THE SIGN OF DIVISION.—A horizontal line placed between two dots ($\div$), read "divided by." It denotes that the quantity on the left is to be divided by that on the right. Thus, $25 \div 5$ signifies that 25 is to be divided by 5, $= 5$.

Table of Units.

12 units	make 1 dozen	(marked doz.).
12 dozen	" 1 gross	(" gro.).
144 "	" 1 great gross	(" gg.).
20 units	" 1 score	(" sc.)
200 lbs.	" 1 barrel of	pork.
196 "	" 1 "	flour.

Paper.

24 sheets	make 1 quire.
20 quires	" 1 ream.
2 reams	" 1 bundle.
5 bundles	" 1 bale.

Apothecaries' Weight.

20 grains	make	1 scruple	(marked	sc.).
3 scruples	“	1 dram	(“	dr.).
8 drams	“	1 ounce	(“	oz.).
12 ounces	“	1 pound	(“	lb.).

NOTE.—This table is used by druggists in compounding medicines.

Avoirdupois Weight.

16 drams	make	1 ounce	(marked	oz.).
16 ounces	“	1 pound	(“	lb.).
2000 pounds	“	1 ton	(“	T.).

NOTE.—This table is used in weighing iron and cotton and in loading vessels.

Surveyor's Measure.

$7\frac{92}{100}$ inches	make	1 link	(marked	l.).
100 links	“	1 chain	(“	ch.).
80 chains	“	1 mile	(“	m.).

Table of Time.

60 seconds	make	1 minute.
60 minutes	“	1 hour.
24 hours	“	1 day and night.
30 days	“	1 month.
12 months	“	1 year.

12 calendar months	} 1 Julian or common
or 365 days	
	year.

NOTE.—360 days make a commercial year.

Federal Money.

10 mills	make	1 cent	(marked	ct.).
10 cents	“	1 dime	(“	dm.).
10 dimes	“	1 dollar	(“	\$).
$12\frac{1}{2}$ cents	“	$\frac{1}{8}$ of	1 dollar.	
$16\frac{2}{3}$ “	“	$\frac{1}{6}$ “	1 “	
25 “	“	$\frac{1}{4}$ “	1 “	
$33\frac{1}{3}$ “	“	$\frac{1}{3}$ “	1 “	
$37\frac{1}{2}$ “	“	$\frac{3}{8}$ “	1 “	
50 “	“	$\frac{1}{2}$ “	1 “	
$62\frac{1}{2}$ “	“	$\frac{5}{8}$ “	1 “	
75 “	“	$\frac{3}{4}$ “	1 “	
$87\frac{1}{2}$ “	“	$\frac{7}{8}$ “	1 “	

English Money.

4 farthings	make	1 penny	(marked	d.).
12 pence	“	1 shilling	(“	s.).
20 shillings	“	1 pound	(“	£).
21 “	“	1 guinea	(“	g.).

1 pound sterling is equal to \$4.84.

1 shilling “ .24 $\frac{1}{5}$ cts.

1 penny “ .02 $\frac{1}{60}$ cts.

Troy Weight.

24 grains	make	1 pennyweight	(dwt.).
20 pennyweights	“	1 ounce	(oz.).
12 ounces	“	1 pound	(lb.).

NOTE.—All jewelry is weighed by this weight.

Square Measure.

144 square inches	make	1 square foot (sq. ft.).
9 square feet	“	1 square yard (sq. yd.).
$30\frac{1}{4}$ square yards	“	1 square rod or pole (sq. rd.).
40 rods	“	1 rood (r.).
4 roods	“	1 acre (a.).
4840 square yards	“	1 acre.
160 square rods	“	1 acre.
10 square chains	“	1 acre.
640 square acres	“	1 mile (sq. m.).

NOTE.—The above is used in surface measure.

Liquid Measure.

4 gills	make	1 pint	(marked pt.).
2 pints	“	1 quart	(“ qt.).
4 quarts	“	1 gallon	(“ gal.).
63 gallons	“	1 hogshead	(“ hhd.).
231 cubic inches	make	1 gallon.	

Dry Measure.

2 pints	make	1 quart	(marked qt.).
8 quarts	“	1 peck	(“ pk.).
4 pecks	“	1 bushel	(“ bu.).
5 bushels	“	1 barrel	(“ bbl.).
2150 $\frac{42}{100}$ cubic inches is equal to 1 bu., and is the U. S. standard.			

Long Measure.

12 inches	make	1 foot	(marked ft.).
3 feet	"	1 yard	(" yd.).
$5\frac{1}{2}$ yards	"	1 rod	(" rd.).
40 rods	"	1 furlong	(" fur.).
8 furlongs	"	1 mile	(" m.).
3 miles	"	1 league	(" lg.).
$69\frac{1}{2}$ miles	"	1 degree	(" deg.).

360 degrees make the circumference of the earth.

4 inches make 1 hand, used in measuring the height of horses.

6 feet make a fathom, used to measure the depth of water.

Cubic Measure.

1728 cubic inches make 1 cubic foot.

27 cubic feet " 1 cubic yard.

40 feet of round or 50 feet } 1 ton.
of hewn timber

42 solid feet make 1 ton of shipping.

128 cubic feet make 1 cord of wood.

Cloth Measure.

$2\frac{1}{4}$ inches make 1 nail (marked na.).

4 nails " 1 quarter (" qr.).

4 quarters " 1 yard (" yd.).

FRACTIONS.

Presuming the pupil to be familiar with the fundamental rules of arithmetic, we commence our work with fractions, and do so by propounding such questions as we think necessary in the premises :

QUESTION. What are fractions ?

ANSWER. Broken units or numbers.

Q. Of how many parts is a fraction composed ?

A. Two ; the numerator and the denominator.

Q. What does the denominator show ?

A. The number of parts into which the unit is broken.

Q. What does the numerator show ?

A. The number of parts taken ?

Q. What is a proper fraction ?

A. One of which the numerator is less than the denominator.

Q. What is an improper fraction ?

A. One whose numerator is greater than the denominator.

Q. What should be done with improper fractions ?

A. They should be reduced to a whole or a mixed number by Rule 1.

RULE 1. *Divide the numerator by the denominator.*

PROP. 1. Change $\frac{75}{4}$ to a whole or a mixed number.

OPERATION.

$$75 \div 4 = 18\frac{3}{4}. \quad \text{Ans. } 18\frac{3}{4}.$$

2. Change $\frac{100}{3}$ to a mixed number.

$$\text{Ans. } 33\frac{1}{3}.$$

3. Change $\frac{203}{12}$ to a mixed number.

$$\text{Ans. } 16\frac{11}{12}.$$

4. Change $\frac{50}{3}$ to a mixed number.

$$\text{Ans. } 16\frac{2}{3}.$$

5. Change $\frac{11}{2}$ to a mixed number.

$$\text{Ans. } 5\frac{1}{2}.$$

QUESTION. What is a mixed number?

ANSWER. A whole number joined or added to a fraction; as, $5\frac{1}{2}$, $16\frac{2}{3}$, $33\frac{1}{3}$, etc.

Q. What should be done with mixed numbers?

A. They should be reduced to improper fractions.

Q. By what rule should they be so reduced?

A. RULE 2. *Multiply the whole number by the denominator of the fraction, and add in the numerator.*

PROP. 1. Reduce $33\frac{1}{3}$ to an improper fraction.

OPERATION.

$$\begin{array}{r} 33\frac{1}{3} \\ \hline 100 \\ \hline 3 \end{array}$$

Ans. $\frac{100}{3}$.

NOTE.—We see that it takes $\frac{3}{3}$ to make the unit; in 33 units there are $\frac{99}{3}$, and $33\frac{1}{3} = \frac{100}{3}$, the answer.

2. Reduce $16\frac{2}{3}$ to an improper fraction.

Ans. $\frac{50}{3}$.

3. Reduce $16\frac{11}{12}$ to an improper fraction.

Ans. $\frac{203}{12}$.

4. Bring $18\frac{3}{4}$ to an improper fraction.

Ans. $\frac{75}{4}$.

5. Bring $2150\frac{42}{100}$ to an improper fraction.

Ans. $\frac{215042}{100}$.

REMARK.—All mixed numbers, wherever or whenever they occur, must be reduced to improper fractions by Rule 2; after which the numerator is to be placed on the same side of the vertical line as the mixed number, with the denominator on the opposite side.

“NOTES” and “REMARKS” must be observed in order to proceed correctly and with understanding.

ADDITION OF FRACTIONS.

RULE. *Multiply all the denominators together for a common denominator, and all the numerators by each denominator except its own; then add the products and place the sum over the common denominator. If the numerator be greater than the denominator, divide the numerator by the denominator.*

PROP. 1. Add $\frac{1}{2}$ and $\frac{2}{3}$. *Ans.* $\frac{7}{6} = 1\frac{1}{6}$.

OPERATION.

$$\frac{1}{2} \times \frac{2}{3} = 6, \text{ common denominator,}$$

$$1 \times 3 = 3$$

$$2 \times 2 = 4$$

$$\frac{7}{6} \div 6 = 1\frac{1}{6}. \quad \text{Ans.}$$

2. $\frac{5}{12} + \frac{7}{8} + \frac{2}{3} = 1\frac{23}{24}$. *Ans.* $1\frac{23}{24}$.

3. $\frac{1}{2} + \frac{1}{3} + \frac{1}{4} = \frac{13}{12} = 1\frac{1}{12}$. *Ans.* $1\frac{1}{12}$.

4. What is the sum of $\frac{1}{3} + \frac{1}{4} + \frac{1}{5} + \frac{1}{6}$?
Ans. $\frac{19}{20}$.

5. What is the sum of $\frac{3}{7} + \frac{1}{2} + \frac{2}{9}$?
Ans. $1\frac{19}{126}$.

6. What is the sum of $\frac{4}{9} + \frac{5}{6} + \frac{2}{5}$?
Ans. $1\frac{61}{90}$.

NOTE.—When the denominators are alike, the operation may be performed by simply adding the numerator and placing the result over the denominator.

PROP. 1. $\frac{3}{8} + \frac{5}{8} + \frac{7}{8} = \frac{15}{8} = 1\frac{7}{8}$. *Ans.* $1\frac{7}{8}$.

NOTE.—In adding mixed numbers it is best to add the whole numbers and the fractions separately.

SUBTRACTION OF FRACTIONS.

RULE. *Reduce the fractions to a common denominator, placing the difference of the numerators over the common denominator, and reduce the fraction to its lowest terms by Rule 1.*

PROP. 1. From $\frac{3}{4}$ take $\frac{3}{8}$. *Ans.* $\frac{3}{8}$.

OPERATION.

$$\frac{3}{4} - \frac{3}{8} = 4)\frac{12}{32} = \frac{3}{8}$$

$$3 \times 8 = 24 - 12 = 12$$

$$4 \times 3 = \frac{12}{12}$$

2. $\frac{3}{5} - \frac{1}{4} = \frac{7}{20}$. *Ans.* $\frac{7}{20}$.

3. From $\frac{1}{2}$ of $\frac{2}{3}$ of $\frac{3}{4} = \frac{1}{4}$ take $\frac{1}{4}$ of $\frac{1}{5}$ of $\frac{2}{3} = \frac{1}{30}$. $\frac{1}{30} - \frac{1}{4} =$ *Ans.* $\frac{13}{60}$.

4. From $18\frac{3}{4}$ take $16\frac{2}{3}$. *Ans.* $2\frac{1}{12}$.

5. I bought of A. J. Baldwin & Co. 9 lbs. 9 oz. of tobacco, and sent back 7 lbs. 3 oz.; how much did I retain? *Ans.* $2\frac{3}{8}$ lbs.

6. On settlement I owed A. R. Stewart $\$41\frac{1}{6}$, and paid him $\$21\frac{1}{7}$; how much remained due?

Ans. $\$24\frac{1}{2}$.

MULTIPLICATION OF FRACTIONS.

RULE 3. *Place all the numerators on the right of a vertical line, and all the denominators on the left.*

PROP. 1. Multiply $\frac{2}{3}$ by $\frac{3}{4}$.

OPERATION.

$$\begin{array}{c|c} 3 & 2 \\ 4 & 3 \quad 1 \\ 2 & \end{array} \quad \text{Ans. } \frac{1}{2}.$$

NOTE.—In the above operation we see that the 3 on the left will cancel the 3 on the right one time; this causes the 1 to be a new numerator. The 2 on the right will cancel the 4 on the left two times; the 2 then becomes a new denominator. Hence the answer, $\frac{1}{2}$.

2. Multiply $\frac{1}{4}$ by $\frac{1}{2}$. Ans. $\frac{1}{8}$.

3. Multiply $\frac{1}{2}$ of $\frac{2}{3}$ of $\frac{4}{5}$ by $\frac{5}{8}$. Ans. $\frac{1}{6}$.

4. What would $\frac{2}{3}$ of $\frac{3}{4}$ of $\frac{4}{5}$ yds. of goods cost, at $\frac{2}{3}$ of $\frac{3}{4}$ dollars per yd.? Ans. $\$ \frac{1}{5}$.

5. Multiply together $\frac{5}{6}$ of $\frac{4}{5}$ of $\frac{3}{4}$ of $\frac{2}{3}$ of $\frac{1}{2}$. Ans. $\frac{1}{6}$.

6. What is the cost of $8\frac{3}{4}$ lbs. beef, at $5\frac{1}{7}$ cts. per lb.?

OPERATION.

$$\begin{array}{c|c} 7 & 36 \\ 4 & 35 \end{array} \quad 9 \times 5 = \quad \text{Ans. 45 cts.}$$

NOTE.— $8\frac{3}{4} = \frac{35}{4}$; $5\frac{1}{7} = \frac{36}{7}$.

7. What will $7\frac{3}{5}$ yds. of ribbon cost, at $12\frac{1}{2}$ cts. per yd. ? *Ans.* 95 cts.

8. Give the cost of $16\frac{2}{3}$ lbs. of bacon, at $8\frac{2}{5}$ cts. per lb. ? *Ans.* \$1.40.

9. What cost $17\frac{1}{2}$ sks. of brand, @ $\$3\frac{3}{5}$ per sk. ? *Ans.* \$63.

10. What cost $18\frac{3}{4}$ yds. muslin, @ $18\frac{3}{4}$ cts. per yd. ? *Ans.* $\$3.51\frac{9}{16}$.

11. Give the cost of $\frac{2}{3}$ of $\frac{3}{4}$ of 50 lbs. coffee, at $12\frac{3}{5}$ cts. per lb. *Ans.* \$3.15.

12. What would be the cost of $4\frac{1}{2}$ of $4\frac{2}{9}$ of $6\frac{3}{4}$ of $4\frac{8}{9}$ lbs. of beef, at $2\frac{1}{4}$ cts. per lb. ? *Ans.* $\$14.10\frac{3}{4}$.

OPERATION.

$4\frac{1}{2}$	$4\frac{2}{9}$	$6\frac{3}{4}$	$4\frac{8}{9}$	$2\frac{1}{4}$	2	9	
$\frac{9}{2}$	$\frac{38}{9}$	$\frac{27}{4}$	$\frac{44}{9}$	$\frac{9}{4}$	9	38	
					4	27	
					9	44	$11 \times 19 \times 27 = 5643 \div 4 = 14.10\frac{3}{4}$
					4	9	

NOTE.—All the numbers on the left are canceled except 4; hence, 4 is the divisor. In all propositions cancel all the numbers that can be canceled without leaving a remainder, after which multiply together all uncanceled numbers on the right, all on the left together, and divide the product of the right by the product of the left. If the product of the left be greater than the product of the right, it will only be “a proper fraction” to be reduced to its lowest terms. No fraction is in its lowest terms as long as both numerator and denominator can be divided by any number greater than 1 and leave a remainder.

To Reduce a Fraction to its Lowest Terms.

RULE 4. *Divide the numerator and the denominator by any number greater than 1 that will go in both without leaving a remainder.*

PROP. 1. Reduce $\frac{4}{16}$ to its lowest terms.

OPERATION.

$$4 \overline{) \frac{4}{16}} = \frac{1}{4}. \quad \text{Ans. } \frac{1}{4}.$$

2. Reduce $\frac{5}{25}$ to its lowest terms. *Ans.* $\frac{1}{5}$.

3. Reduce $\frac{50}{100}$ to its lowest terms. *Ans.* $\frac{1}{2}$.

4. Reduce $\frac{15}{17}$ to its lowest terms. *Ans.* $\frac{15}{17}$.

5. Reduce $\frac{3}{8}$ to its lowest terms. *Ans.* $\frac{3}{8}$.

6. Reduce $\frac{16}{48}$ to its lowest terms. *Ans.* $\frac{1}{3}$.

7. Reduce $\frac{9}{12}$ to its lowest terms. *Ans.* $\frac{3}{4}$.

8. Reduce $\frac{8}{20}$ to its lowest terms. *Ans.* $\frac{2}{5}$.

To Multiply a Whole Number by a Fraction.

RULE 5. *Place the whole number and the numerator of the fraction on the right, and the denominator of the fraction on the left.*

PROP. 1. What will 480 peanuts cost, at $\frac{7}{8}$ cts. each?

OPERATION.

$$\begin{array}{r|l} 480 & \\ 7 \times 60 = 420. & \end{array} \quad \text{Ans. } \$4.20.$$

2. What will 448 lbs. of cotton be worth, at $8\frac{1}{4}$ cts per lb. ? Ans. \$36.96.

OPERATION.

$$8\frac{1}{4} = \frac{33}{4} \quad \begin{array}{r|l} 4 & 448 \\ \hline & 33 \times 112 = 36.96 \end{array}$$

3. Give the cost of 880 lbs. of meat, @ $6\frac{1}{4}$ cts. per lb. Ans. \$55.00.

4. Multiply 10 by $3\frac{1}{2}$. Ans. 35.

5. Multiply $10\frac{1}{2}$ by $3\frac{1}{2}$. Ans. $36\frac{3}{4}$.

6. Multiply $5\frac{1}{2}$ by $5\frac{1}{2}$. Ans. $30\frac{1}{4}$.

7. What is the cost of $5\frac{1}{2}$ lbs. candy, at $5\frac{1}{2}$ cts. per lb. ? Ans. $30\frac{1}{4}$ cts.

8. What would $\frac{8}{9}$ of $\frac{7}{8}$ of $\frac{6}{7}$ of $\frac{5}{6}$ of $\frac{4}{5}$ yds. of goods cost, at $\frac{1}{2}$ of $\frac{2}{3}$ of $\frac{3}{4}$ of $\frac{4}{5}$ cts. per yd. ?

Ans. $\frac{4}{45}$ cts.

DIVISION OF FRACTIONS.

RULE 6. *Place the numerators of the dividend on the right and the numerators of the divisors on the left, with the denominators on the opposite side. Or, place on the right all the numerators preceding the word "by," those following on the left, with the denominators on the opposite side.*

NOTE.—The rule within itself: Invert the terms.

PROP. 1. Divide $\frac{1}{2}$ by $\frac{1}{4}$. Ans. 2.

OPERATION.

$$\begin{array}{r|l} 2 & 1 \\ 1 & 4 \quad 2 \end{array}$$

2. Divide $\frac{1}{2}$ of $\frac{2}{3}$ by $\frac{2}{3}$ of $\frac{3}{4}$. *Ans.* $\frac{2}{3}$.

3. Divide $\frac{1}{7}$ by $\frac{1}{8}$. *Ans.* $1\frac{1}{7}$.

4. Divide $\frac{9}{28}$ of $\frac{14}{21}$ of $\frac{8}{9}$ of $\frac{3}{7}$ by $\frac{22}{35}$ of $\frac{5}{11}$.
Ans. $\frac{2}{7}$.

5. Divide $\frac{1}{2}$ of $\frac{2}{3}$ of $\frac{3}{4}$ of $\frac{4}{5}$ of $\frac{5}{6}$ by $\frac{2}{3}$ of $\frac{3}{4}$.
Ans. $\frac{1}{3}$.

6. Divide $\frac{3}{7}$ of $\frac{8}{9}$ of $\frac{14}{21}$ of $\frac{9}{28}$ by $\frac{5}{11}$ of $\frac{22}{35}$.
Ans. $\frac{2}{7}$.

7. Divide $\frac{3}{7} \times \frac{7}{9} \times \frac{8}{1}$ by $\frac{4}{8} \times \frac{8}{12} \times \frac{6}{1}$.
Ans. $1\frac{1}{3}$.

8. Divide $4\frac{4}{9} = \frac{40}{9}$ by $\frac{5}{9}$ of $\frac{4}{15}$. *Ans.* 30.

9. I bought $34\frac{3}{8}$ bu. of wheat, for which 1 paid $\$68\frac{3}{4}$; what was the cost per bu.?

Ans. \$2.

OPERATION.

$$68\frac{3}{4} = \frac{275}{2}; \quad 34\frac{3}{8} = \frac{275}{8}.$$

$$\begin{array}{r|l} 4 & 275 \\ 275 & 8 = 2 \end{array}$$

10. We bought $13\frac{1}{2}$ lbs. candy for $94\frac{1}{2}$ cts.; what was the cost per lb.?

Ans. 7 cts.

NOTE.—Divide $94\frac{1}{2}$ by $13\frac{1}{2}$, = cost, 7 cts.

11. Divide $18\frac{3}{4} \times 6\frac{1}{4}$. *Ans.* 3.

12. Divide $\frac{4}{9}$ of $\frac{3}{8}$ by $\frac{2}{7}$ of $\frac{6}{9}$; multiply the quotient by $\frac{4}{7}$ of $\frac{8}{9}$ of $\frac{2}{1}$; divide the product by $\frac{4}{5}$ of $\frac{5}{6}$ of $9\frac{1}{2}$, = $\frac{19}{2}$; multiply this quotient by $\frac{38}{40}$ of 480.
Ans. 64.

13. What number multiplied by $\frac{1}{2}$ of $\frac{2}{3}$ of $\frac{3}{4}$ will produce 1000? *Ans.* 4000.

NOTE.—Divide 1000 by $\frac{1}{2}$ of $\frac{2}{3}$ of $\frac{3}{4}$ to find the number sought.

14. What number multiplied by $\frac{3}{8}$ of $\frac{2}{3}$ will give 60? *Ans.* 240.

To Divide a Whole Number by a Fraction.

RULE 7.—Place the whole number and the denominator of the fraction on the right, and the numerator of the fraction on the left.

PROP. 1. Divide 12 by $\frac{3}{4}$. *Ans.* 16.

OPERATION.

NOTE.—12 units = $\frac{12}{1}$, so you divide $\frac{12}{1}$

$$\begin{array}{r} 3 \overline{) 12} \\ 4 \times 4 = 16 \end{array} \quad \text{by } \frac{3}{4}, = 16.$$

2. Divide 16 by $\frac{3}{5}$. *Ans.* $26\frac{2}{3}$.

3. Divide 48 by $4\frac{4}{5} = \frac{24}{5}$. *Ans.* 10.

4. Divide 100 by $\frac{25}{50}$. *Ans.* 200.

5. What number multiplied by $\frac{2}{3}$ of $\frac{3}{4}$ of $\frac{4}{5}$ will give 100? *Ans.* 250.

PROOF.—Multiply 250 by $\frac{2}{3}$ of $\frac{3}{4}$ of $\frac{4}{5}$ and see the proof.

OPERATION.

$$\begin{array}{r} 3 \overline{) 250} \\ 4 \overline{) 2} \\ 5 \overline{) 3} \end{array} \quad 50 \times 2 = 100.$$

COMPLEX FRACTIONS.

These are such as have a fractional numerator or a fractional denominator, or sometimes both. Fractions denote division. The numbers above the line are to be regarded as the dividends, while those below are the divisors, and the example is to be worked out as in the division of fractions, under Rule 6.

For instance, what part of a foot is $6\frac{3}{4}$ in.?

It equals $\frac{6\frac{3}{4}}{12}$; then we regard the $6\frac{3}{4}$ inches as the dividend and the 12 as the divisor, and, divided, $6\frac{3}{4} = \frac{27}{4}$ by 12.

OPERATION.

$$\begin{array}{r} 4 \overline{) 27} = 3) \frac{27}{4} = \frac{9}{1\frac{1}{3}} \text{ reduced.} \\ \underline{12} \\ 48 \end{array}$$

To Reduce Complex Fractions to Simple Ones.

RULE 8. *Consider the numerator as the dividend, the denominator as the divisor, and proceed as directed by Rule 6.*

PROP. 1. Reduce $\frac{6\frac{2}{3}}{\frac{2}{3}}$. $6\frac{2}{3} = \frac{20}{3}$; then divide $\frac{20}{3}$ by $\frac{2}{3}$.

OPERATION.

$$\begin{array}{r} 3 \overline{) 20} = 10 = \\ \underline{2} \end{array} \quad \text{Ans. 10.}$$

2. Reduce $\frac{8\frac{3}{4}}{12}$ to the simple fraction of a foot.

Ans. $\frac{35}{48}$.

3. Reduce $\frac{3\frac{3}{4}}{5\frac{5}{8}}$ to a simple fraction. *Ans.* $\frac{2}{3}$.

4. Reduce $\frac{16\frac{2}{3}}{25}$ to a simple fraction. *Ans.* $\frac{2}{3}$.

5. What part of a yard is $18\frac{3}{4}$ inches?

Ans. $\frac{25}{48}$.

Lumber Measure.

RULE 9. *Place the number of pieces, with the length, width and thickness, on the right; on the left, 12, or its factors, 3 and 4.*

PROP. 1. How many feet in 100 planks 12 ft. long, 9. in. wide and 1 in. thick?

Ans. 900 ft.

OPERATION.

$$\begin{array}{r|l} 12 & 100 \\ & 12 \\ & 9 \times 100 = 900. \end{array}$$

NOTE.—We use the 12 (or its factors) on the left to reduce it to feet. Were we to multiply the length in inches it would give 144 times too much. To bring the contents in feet for board measure, we divide by 12.

2. How many feet in 400 pieces 18 ft. long 6 in. wide and 4 in. thick? *Ans.* 14400.

3. What number of feet in 144 planks 16 ft. long, 6 in. wide, 1 in. thick? *Ans.* 1152 ft.

4. Give the number of feet in 36 planks 12 ft. long, 8 in. wide, 1 in. thick. *Ans.* 288 ft.

5. What number of feet in 20 pieces of lumber 36 ft. long, 5 in. wide, 3 in. thick?

Ans. 900 ft.

6. Give the number of feet in 25 scantling 15 ft. long, 4 by 3 in. *Ans.* 375 ft.

7. How many feet in 12 planks $12\frac{1}{2}$ ft. long, $12\frac{1}{2}$ in. wide and 2 in. thick? *Ans.* $312\frac{1}{2}$ ft.

8. How many feet in 120 pieces of lumber $11\frac{1}{4}$ ft. long, $9\frac{7}{9}$ in. wide and $1\frac{9}{11}$ in. thick?

Ans. 2000 ft.

9. How many feet in, and what would be the cost of, 32 planks $16\frac{2}{3}$ ft. long, $6\frac{3}{4}$ in. wide and 1 in. thick, at $\$1\frac{2}{3}$ per hundred feet?

Ans. 300 ft.; cost, \$5.

10. How much lumber in, and what is the cost of, 20 pieces 7 ft. long and 4 by 6 in., at $\$2\frac{1}{2}$ per hundred feet? *Ans.* 280 ft.; cost, \$7.

11. How many feet in 800 pickets 12 ft. long, $1\frac{1}{2}$ in. wide and $1\frac{1}{4}$ in. thick?

Ans. 1500 ft.

For Tapering Timber.

RULE 10. *Add together the areas of the two ends, and place the sum, also the length, on the right ; on the left, 2, 12.*

NOTE.—The 2 denotes a mean of the areas of the two ends, and the 12 is to reduce to feet for board measure.

The same rule will produce a correct result whether there be any taper or not.

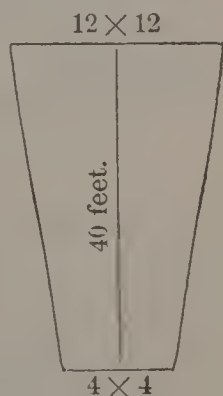
PROP. 1. How many feet board measure in a stick of timber 40 ft. long, 12×12 in. at the large end and 4×4 in. at the small ?

Ans. $266\frac{2}{3}$ ft.

OPERATION.

$$\begin{aligned} 12 \times 12 &= 144, \text{ area large end,} \\ 4 \times 4 &= \underline{16}, \text{ area small end,} \\ 160 &= \text{united areas.} \end{aligned}$$

$$\begin{array}{r} 2 \overline{) 160} \\ 3 \overline{) 40} \\ 4 \quad 10 \times 80 = 800 \div 3 = \text{Ans. } 266\frac{2}{3} \text{ ft.} \end{array}$$



2. How many feet board measure in 20 scantling 20 ft. long, 4×5 in. at the large end and 2×3 in. at the small end ? Ans. $433\frac{1}{3}$ ft.

3. Give the contents in board measure of a piece of timber 10×10 in. at one end and 6×6 in. at the other, and 20 ft. long.

Ans. $133\frac{1}{3}$ ft.

4. How many feet in a ship's mast, 20×20 in. at the large end and 4×4 in. at the other, 60 ft. long? and what would be the cost at $\$11\frac{1}{2}$ per hundred ft.? *Ans.* 1040 ft. ; cost, \$15.60.

Land Measure in Rods.

RULE 11. *Place the length and the width, in rods, on the right ; on the left, 160, or its factors, 4, 10, 4.*

PROP. 1. How many acres in a field 80 rds. long and 40 rds. wide? *Ans.* 20 acres.

OPERATION. **NOTE.**—The length and the width in rods on the right equal the number of square rods in the field. We use 160 or its factors as a divisor to obtain acres : 160 sq. rds. = 1 acre.

$$\begin{array}{r|l} 160 & 80 \\ 2 & 40 = 20 \end{array}$$

2. How many acres in a lot of land 180 rd. each way? *Ans.* $202\frac{1}{2}$ A.

3. What is the area of a field in acres, 160 rd. in length and 40 rd. wide? *Ans.* 40 A.

4. We have a patch 40 rd. in length and 4 rd. in width ; how many acres? *Ans.* 1 A.

Land Measure in Yards.

RULE 12. *Place the length and the width, in yards, on the right ; on the left, 4840, or its factors, 11, 11, 10, 4.*

PROP. 1. How many acres in a tract of land 1100 yds. each way? Ans. 250 A.

OPERATION.

$$\begin{array}{r|rrrr}
 11 & 1100 & 100 & 10 & \\
 11 & 1100 & 100 & & \\
 10 & & & & \\
 4 & & & &
 \end{array}
 \quad 25 \times 10 = 250.$$

NOTE.—11, 11, 10, 4 = 4840; then, as 4840 sq. yd. = 1 A., we use it on the left as a divisor.

2. How many acres of land are embraced in the right of way of the S. W. R. R. from Macon to Eufaula, 140 m., and the right of way 50 yds.? Ans. $2545\frac{5}{11}$ A.

NOTE.—Reduce the length to yards and work under Rule 12.

OPERATION.

$$\begin{array}{r|l}
 11 & 140 \text{ miles} \\
 11 & 1760 \text{ yds.} = 1 \text{ mile} \\
 10 & 50 \text{ " } = \text{right of way} \\
 4 & 440 \\
 & 44 \quad 4 \times 50 \times 140 = 28000 \div 11 = 2545\frac{5}{11}.
 \end{array}$$

Land Measure in Chains.

RULE 13. *Place the length and the width, in chains, on the right, and 10 on the left.*

PROP. 1. How many acres in a plat of land 40 ch. long and the same in width?

Ans. 160 A.

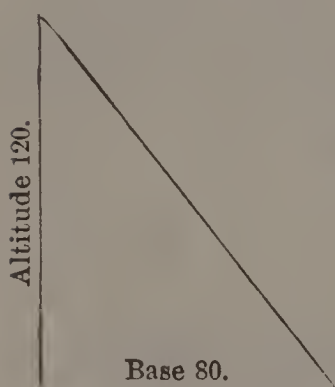
OPERATION.

$$\begin{array}{r|l} 10 & 40 \\ \hline & 40 \times 4 = 160. \end{array}$$

NOTE.—10 sq. ch. is equal to 1 A.; hence, we use it as the divisor.

To Find the Area of a Triangle.

RULE 14. *Multiply half the altitude by the base, or half the base by the altitude, and place the product on the right; on the left, the standard of acres. If yards, 11, 11, 10, 4; if rods, 4, 10, 4; if chains, 10.*



PROP. 1. How many acres in a triangle, base 80 rd., altitude 120 rd.?

OPERATION.

$$\begin{array}{r|l} \frac{1}{2} \text{ the alt.} & 60 & 11 & 4800 \\ \text{Base} & 80 & 10 & 1200 \\ \hline & 4800 & 4 & 120 \quad 30 \\ & & & \text{Ans. 30 A.} \end{array}$$

2. We have a small field of a triangular shape; the base is 36 rd.; altitude, 90 rd. What is its area in acres?
Ans. $10\frac{1}{8}$ A.

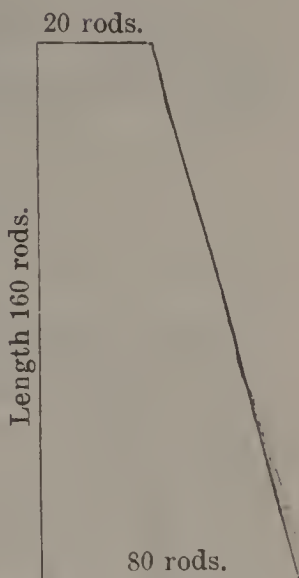
NOTE.—The area of any plat of land of a triangular shape—narrow at one end and broad at the other—can be obtained by adding the two ends together and dividing by 2; this will give the average width.

NOTE.—If the field is 160 rods long and 80 rods in width at one end and 20 rods at the other, we see the length = 160 rd.; and when we add the two ends, $80 + 20 = 100$, half of which is 50; so the mean width is 50 rods.

Ans. 50 A.

OPERATION.

$$\begin{array}{r|l} 4 & 160 \quad 16 \\ 16 & 50 = \text{Ans.} \\ 4 & \end{array}$$



3. John M. Fulton has a field $46\frac{1}{5}$ rd. wide at the north end, $81\frac{4}{5}$ rd. at the south end, and 90 rd. in length. What is its area in acres?

Ans. 36 A.

NOTE.—We cannot impart a knowledge of surveying in a work like the present, though the rules given for land measure, together with “common sense,” will enable us to get the area of a plot of land of almost any ordinary shape. Hence we deem it unnecessary to dwell longer upon the subject of Land Measure. Rule 39 will be found convenient for the farmer.

To Find the Number of Cords in a Pile of Wood.

RULE 15. *Place the length, the width and the height of the pile, in feet, on the right; on the left, 4, 8, 4.*

PROP. 1. How many cords in a pile of wood 16 ft. long, 8 ft. broad and 4 ft. high?

Ans. 4 cds.

OPERATION.

$$\begin{array}{r|l} 4 & 16 = 4 \\ 8 & 8 \\ 4 & 4 \end{array}$$

NOTE.—The 4, 8, 4 on the left are the factors of 128, there being 128 cu. ft. in a cord. In other words, a pile of wood 8 ft. long, 4 ft. broad and 4 ft. high contains 1 cord of wood.

2. H. B. Elder has a house 40 ft. long, 16 ft. wide and 8 ft. high; how many cords of tanbark can be put in said house?

Ans. 40 cds.

3. How many cords of bark can Harper Black store away under his shed, which is 64 ft. long, 24 ft. wide and 12 ft. high? and what would be the cost of the same, at $\$1\frac{3}{4}$ per cd.?

Ans. 144 cd.; cost, \$252.

4. Give the number of cords in a pile of wood $33\frac{1}{3}$ ft. long, $8\frac{1}{2}$ ft. broad and $4\frac{1}{2}$ ft. high.

Ans. $9\frac{1}{2}\frac{3}{8}$ cds.

To Gauge a Box or a Granary.

RULE 16. *Place the length, the width and the depth of the box, in feet, and 4, on the right; on the left, 5.*

PROP. 1. How many bushels of wheat will be held by a box which is 5 ft. long, 4 ft. broad and 4 ft. deep? *Ans.* 64 bu.

NOTE.—We allow $1\frac{1}{4}$ cu. ft. to the bushel, which is not precisely correct, though very near it. We divide the number of cubic feet in the box by $1\frac{1}{4}$, which $=\frac{5}{4}$; so this gives the 5 on the left and the extra 4 on the right.

2. How many bushels of wheat can Capt. J. J. Harper put in a wheat-house which is 10 ft. long, 4 ft. broad and 3 ft. deep? *Ans.* 96 bu.

To Gauge Corn in the Ear.

RULE 17. *Place the length, the width and the depth of the barn, in feet, with 2, on the right, and 5 on the left.*

PROP. 1. How many bushels will be contained by a barn which is 20 ft. long, 15 ft. wide and 8 ft. deep? *Ans.* 960 bu.

OPERATION.

$$\begin{array}{r|l} & 20 \\ 5 & 15 \\ & 8 \\ & 2 \times 3 \times 8 \times 20 = 960 \text{ bu.} \end{array}$$

NOTE.—For corn in the ear, with no shuck, we allow $2\frac{1}{2}$ cu. ft. to the bushel, though if in the shuck such deduction can be made as is thought necessary after seeing the corn. The rule is offered only as a general rule, as it

would be impossible to furnish a correct one for corn in bulk. The rule is based upon the principle that 2 bushels of corn in the ear, with no shuck, is equal to 1 bushel shelled.

2. My neighbor Mr. John Mattox has a barn 20 ft. long, 18 ft. wide and 10 ft. deep; how many bushels of unshucked corn will it hold, allowing $\frac{1}{3}$ off for shuck?

Ans. 960 bu.

NOTE.—If it be desired to obtain the result in barrels, put an extra 5 on the left, as 5 bu. = 1 bbl.

3. How many bushels in a crib $15\frac{3}{4}$ ft. long, $7\frac{1}{2}$ ft. high and $6\frac{2}{3}$ ft. deep, provided it be full of corn with no shuck? and how many bbls.?

Ans. $302\frac{2}{5}$ bu. ; $60\frac{1}{2}\frac{2}{5}$ bbls.

To Find the Number of Bricks necessary to Build a Wall.

RULE 18. *Place the length, the height and the thickness of the wall, in feet, with 1728, on the right; on the left place the length, the width and the thickness of the bricks, in inches.*

PROP. 1. How many bricks 8 in. long, 4 in. broad and 2 in. thick will be required to build a wall 800 ft. long, 4 ft. high and 2 ft. thick?

Ans. 172800 bricks.

OPERATION.

$$\begin{array}{r|l}
 8 & 800 \\
 4 & 4 \\
 2 & 2 \\
 \hline
 & 1728 \times 100 = 172800.
 \end{array}$$

NOTE.—The number 1728, on the right, is used to bring the cubic contents of the wall to cubic inches, which must be done, as the dimensions of the bricks are in inches on the left.

2. What number of bricks 8 in. long, 4 in. wide and 2 in. thick will be required to build a wall 240 ft. long, 6 ft. high and 2 ft. thick?

Ans. 77760 bricks.

3. Required the number of bricks $8\frac{1}{2}$ in. long, $4\frac{2}{3}$ in. wide and $2\frac{1}{2}$ in. thick necessary to build a wall $933\frac{1}{3}$ ft. long, $6\frac{1}{2}$ ft. high and $2\frac{1}{2}$ ft. thick.

Ans. 269568 bricks.

4. How many bricks $8 \times 4 \times 2$ in. will be required to build a house 80 ft. long, 40 ft. wide and 20 ft. high, the walls to be 2 ft. thick?

Ans. 250560 bricks.

NOTE.—It must be remembered that the side-walls take up 2 ft. from each end. Then we have two side-walls, 80 ft. (=160 ft.), and two end-walls, 36 ft. (=72 ft.); so in the four walls we have one wall 232 ft. long, 20 ft. high and 2 ft. thick.

5. Hon. Joseph E. Brown wishes to erect a building with bricks 8 in. long, 4 in. wide and

3 in. thick, the building to be 210 ft. long, 40 ft. wide and 30 ft. high. Leaving $\frac{1}{5}$ for corners, doors and windows, how many bricks will be required, allowing the walls to be 2 ft. thick?

Ans. 432000 bricks.

To Find the Number of Bricks required to Pave a Yard or a Walk.

RULE 19. *Place the length and the width of the yard, in feet, with 144, on the right; on the left, the length and the width of the bricks, in inches.*

PROP. 1. How many bricks 8 by 4 in. will be required to pave the floor of the court-house in Oglethorpe, Ga., the edifice being 80 ft. long and 40 ft. wide?

Ans. 14400 bricks.

OPERATION.

$$\begin{array}{r|l} 8 & 80 \\ 4 & 40 \\ \hline & 144 \times 10 \times 80 = 14400. \end{array}$$

NOTE.—As the dimensions of the bricks are in inches and for surface measure, we use the 144 extra on the right to bring the surface to square inches: 144 sq. in. = 1 sq. ft.

2. How many bricks 6×6 in. will be re-

SHINGLES OR BOARDS TO COVER A ROOF. 39

quired to pave a walk 1200 yd. (or 3600 ft.) in length and 16 ft. wide?

Ans. 230400 bricks.

NOTE.—Always reduce the length and the width to feet.

3. How many bricks 8×4 in. would it take to pave a space 47 miles long and 4 ft. wide?

Ans. 4466880 bricks.

To Find the Number of Shingles or Boards that will Cover a Roof.

RULE 20. *Place on the right the length of the roof, in feet, with double the length of rafters, in feet, also 144; on the left the width of the shingles or boards and the number of inches exposed to the weather.*

PROP. 1. How many shingles 4 in. wide, with 6 in. exposed to the weather, will be required to cover a house 30 ft. long, having rafters 12 ft. long? *Ans.* 4320 shingles.

OPERATION.

$$\begin{array}{r|l} 4 & 30 \\ 6 & 24 \\ \hline & 144 \times 30 = \text{Ans. } 4320. \end{array}$$

NOTE.—The 144 on the right reduces the square contents of the roof to square inches: 144 sq. in. = 1 sq. ft.

2. How many shingles will it take to cover a house 60 ft. long, rafters to be $23\frac{1}{2}$ ft., shingles $3\frac{1}{2}$ in. wide, with 6 in. exposed to the weather?

Ans. 19337 + shingles.

3. I wish enough boards to cover a barn 40 ft. long, with rafters 18 ft., the boards to average 6 in. wide and 8 in. exposed; how many will be required?

Ans. 4320 boards.

4. How many shingles $3\frac{1}{2}$ in. wide and $5\frac{1}{2}$ in. exposed to the weather will be required for a building 55 ft. long, the rafters $17\frac{1}{2}$ ft. long?

Ans. 14400 shingles.

NOTE.—After adding the length of the rafters, in feet, if the sum be a mixed number, it must be reduced to an improper fraction, as all others.

For Cutting Rafters.

RULE 21. *Place the width of the house and 3 on the right; on the left, 5.*

PROP. 1. How long should a rafter be cut for a house 30 ft. wide? *Ans.* 18 ft.

OPERATION.

$$\begin{array}{r|l} 5 & 30 \\ & 3 \times 6 = 18 \text{ ft.} \end{array}$$

NOTE.—While we take 3 ft. of the end-plate, we take 5 ft. of rafter; then place 3 on the right and 5 on the left. We can give no perfect rule, as some desire one pitch and some another, though the one above is the most general.

2. We wish rafters for a building 40 ft. wide; what should be the length? *Ans.* 24 ft.

3. What should be the length of rafters for a building 24 ft. wide? *Ans.* $14\frac{2}{5}$ ft.

NOTE.— $\frac{2}{5}$ of 1 ft. = $4\frac{2}{5}$ in., because $\frac{2}{5}$ of 12 = $4\frac{2}{5}$.

4. J. L. Hand erects a mill-shed 80 ft. long and 30 ft. wide, and wishes a shingle roof; how many shingles 4 in. wide, with 6 in. exposed to the weather, would be required? and what the cost, at $\$2\frac{1}{4}$ per M.?

Ans. 17280 shingles; cost, \$38.88.

NOTE.—The rafters will be 18 ft. long by Rule 21; then, by Rule 20, the desired number of shingles can be found.

To Find the Number of Yards of Carpeting needed to Carpet a Floor.

RULE 22. *Place the length and the width of the floor, in feet, with 4, on the right; on the left, the width of the carpeting, in inches.*

PROP. 1. How many yards of carpeting 36 in. wide will be required to carpet a floor 20 ft. long and 18 ft. wide? *Ans.* 40 yd.

OPERATION.

$$\begin{array}{r|l} 2 & 20 \\ 36 & 18 \\ \hline & 4 \times 10 = 40. \end{array}$$

NOTE.—It will be observed that 36 in. = $\frac{36}{4} = 9$ sq. ft. Thus, 40 in. wide = $\frac{40}{4} = 10$ sq. ft., and so on to any width.

2. How much carpeting $1\frac{1}{4}$ yd. (or 45 in.) wide will be required to carpet a hall 90 ft. long and 45 ft. wide? and what will be the cost, at $\$2\frac{1}{4}$ per yd.?

Ans. 360 yd.; cost, \$810.

3. How many yards of carpeting 45 in. wide will be required to carpet a floor 21 ft. 3 in. ($= 21\frac{1}{4}$ ft.) long, 13 ft. 6 in. ($= 13\frac{1}{2}$ ft.) wide?

Ans. $25\frac{1}{2}$ yd.

4. What number of yards of carpeting $\frac{3}{4}$ yd. wide will carpet a floor 30 ft. long, 20 ft. wide? and what will be the cost, at $\$1\frac{3}{4}$?

Ans. $88\frac{8}{9}$ yd.; cost, \$155.55 +.

5. How many yards of bagging 60 in. wide will carpet a court-room 40×60 ft.?

Ans. 160 yd.

For Computing Interest.

RULE 23. *Place the principal, the number of months and the rate per cent. on the right; on the left, 12, or 3 and 4. If days be expressed, place the principal, the number of days and the rate per cent. on the right; on the left, 360, or the factors 4, 9, 10. If the principal be dollars only, point off 2; if dollars and cents, point off 4.*

PROP. 1. What is the interest of \$400 for 2 mo., at 6 per cent. per annum? *Ans.* \$4.

OPERATION.

$$\begin{array}{r|l} 12 & 4.00 = 4.00. \\ & 2 \\ & 6 \end{array}$$

NOTE.—We reason thus: If 12, on the left, which represents the time one year, will give the given rate per cent., on the right, what would the given principal and the given time, on the right, produce? In the above proposition we say, If 12 mo., on the left, will gain 6 cts., what would \$400 produce in 2 mo.?

When we work by days, we reason thus: If 360 days, on the left, will give the given rate per cent., on the right, what would the given principal and the given number of days, on the right, produce?

2. What is the interest on \$480 for 2 yr. and 6 mo., at 8 per cent.? *Ans.* \$96.

3. Give the interest on \$4750 for 9 mo., at 6 per cent. *Ans.* \$213.75.

4. What is the interest on \$480 for 3 yr. 2 mo., at $10\frac{3}{4}$ per cent.? *Ans.* \$163.40.

5. Give the interest on \$10,000 for 3 mo., at 8 per cent. *Ans.* \$200.

6. What is the interest of \$60 for 1 yr. 8 mo., at 7 per cent.? *Ans.* \$7.00.

7. At 7 per cent. for $2\frac{1}{2}$ yr., what is the interest of \$40? *Ans.* \$7.00.

8. What is the interest on \$400 for 300 days, at 9 per cent.? *Ans.* \$30.

OPERATION.

$$\begin{array}{r|l} 360 & 400 \\ 40 & 300 \times 10 = 30,00 = \text{Ans.} \\ & 9 \end{array}$$

NOTE.—If 360 days, on the left, will give 9 cents, what would \$400 give in 300 days?

9. What is the interest on \$180 for 400 days, at 6 per cent.? *Ans.* \$12.

10. Give the interest on \$360 for 2 yr. 3 mo. 20 da., at 8 per cent. *Ans.* \$66.40.

NOTE.—In 2 yr. and 3 mo. there are 27 mo. = 810 days, which, with 20 days, = 830 days. Then, if 360 days will give 8 cents, what would \$360 give in 830 days? Whenever days are expressed—years, months and days—the time must be reduced to days before placing on the line.

11. Give the interest on \$24,000,000 for 1 da., at 3 per cent. per annum. *Ans.* \$2000.

12. Supposing William H. Vanderbilt's wealth to be \$200,000,000, what is it worth for 1 da., at 6 per cent. per annum?

Ans. \$33,333.33 $\frac{1}{3}$.

13. What is the interest on \$42 for 8 mo., at 10 per cent.?

Ans. \$2.80.

NOTE.—When the amount is wanted, the principal and the interest are added together, and the sum equals the amount.

14. What is the amount of \$180, at 8 per cent., for 2 yr. 3 mo. and 20 da.?

Ans. \$213.20.

OPERATION.

\$33.20 Int.

180.00 Prin.

\$213.20 Amt.

To ascertain the Time that elapses from One
Date to Another.

RULE 24. *Place the latest given date under the earliest—year under year, month under month, days under days, reckoning 12 months to the year and 30 days to the month—and then work under the explanatory note.*

PROP. 1. What time elapses from March 14, 1858, to August 8, 1860?

Ans. 2 yr. 4 mo. 24 da.

OPERATION.

yr.	mo.	da.
1860	8	8
1858	3	14
2	4	24

NOTE.—The latest given date is 1860, the 8th month and 8th day; the earliest, 1858, 3d month, 14th day. The year 1858 is placed under 1860, the 3d month under the 8th month, and 14 days under 8 days. We cannot take 14 days from 8 days, so we borrow 1 month (30 days) and put it to the 8 days, which gives us 38 days. We then subtract 14 days from 38 days, which leaves us 24 days. It is proper now to pay back the 1 month borrowed, so we carry it to the 3d month, and say, “4 months from 8 months leaves 4 months,” and set the 4 months under months. Then, 1858 from 1860 leaves the answer, 2 yr. 4 mo. 24 da.

2. A person was born on the 18th of December, 1835, and died on the 12th of August, 1875; what was his age at death?

Ans. 39 yr. 7 mo. 24 da.

OPERATION.

yr.	mo.	da.
1875	8	12
1835	12	18
39	7	24

NOTE.—We cannot take 18 days from 12 days, but we borrow 1 month, or 30 days, and put to 12 days, which gives us 42 days. We then say, “18 days from 42 days leaves 24 days.” Now, as we borrowed 1 month from the 8 months, it left the 8 months only 7 months. We now see that we cannot take 12 months from 7 months, so we borrow 1 year, or 12 months, and put to 7 months, which gives 19 months. We then say, “12 months from 19 months leaves 7 months.” Now, as we have taken 1 year from 1875, 1874 is left. Then, 1835 years from 1874 years leaves 39 years.

3. America, it is said, was discovered October 11, 1492; how long to September 1, 1886?

Ans. 393 yr. 10 mo. 20 da.

Interest from One Date to Another.

PROP. 1. Give the interest on a note of \$480 from June 19, 1885, to July 1, 1886, at 7 per cent.

Ans. \$34.72.

2. What is the interest on a note made on the 2d of January, 1885, for \$900, and paid on the 30th of November, 1885, at 7 per cent.?

Ans. \$57.40.

3. What is the interest on a note of \$6000 for 6 days, at 6 per cent.?

Ans. \$6.00.

4. What is the amount of \$600 for 6 days, at 6 per cent.?

OPERATION.

.60 Int.
\$600.00 Prin.
\$600.60 Amt.

5. Give the interest on \$360 for 6 days, at 18 per cent. *Ans.* \$1.08.

6. What is the interest on \$1200 for 18 days, at 2 per cent. per month (= 24 per cent. per annum)? *Ans.* \$14.40.

NOTE.— $\frac{3}{4}$ per cent. per mo. = 9 per cent. per annum.

1	"	"	= 12	"	"
$1\frac{1}{4}$	"	"	= 15	"	"
$1\frac{1}{2}$	"	"	= 18	"	"
2	"	"	= 24	"	"
$2\frac{1}{2}$	"	"	= 30	"	"

7. What interest is due A. J. Moyer on a note of \$600 which is overdue 45 days, at $21\frac{1}{2}$ per cent. per month? *Ans.* \$22.50.

8. Give the interest on \$18 for 18 days, at 18 per cent. per annum. *Ans.* $16\frac{1}{5}$ cts.

Bank Discount.

Bank discount is only simple interest paid in advance and reckoned for 3 days more than the given time. These 3 days are called "days of grace."

RULE 25. *Place the principal, the number of days (with 3 days annexed) and the rate per cent. on the right; on the left, 360, or 4, 9, 10*

PROP. 1. What is the bank discount on \$360, payable in 33 days, at 6 per cent.?

Ans. \$2.16.

OPERATION.

360	360
	36
	6
	2.16

NOTE.—The 33 days, with the 3 days of grace added, equal 36 days. Bank discount is worked, like interest, by days, except that 3 days are added for grace.

2. What is the bank discount on \$1000, payable in 90 days, at 18 per cent.?

Ans. \$46.50.

3. What is the present worth of a note of \$360, due 77 days hence, discounted at bank at 6 per cent.?

Ans. \$355.20.

NOTE.—When the present worth is wanted, the discount is subtracted from the principal, and the remainder is the present worth.

4. What is the bank discount of a note of \$36,000, due 97 days hence, discounted at $18\frac{3}{4}$

per cent.? and what is the present worth of the note?

Ans. The discount, \$1875, taken from the principal, = \$34,125, present worth.

5. Give the bank discount on \$5000, due in 15 days, at 6 per cent. *Ans.* \$15.

6. What is the bank discount on a draft of \$360, for 4 mo. 15 da., at 6 per cent.?

Ans. \$8.28.

Commercial Discount.

RULE 26. *Get the amount of 100 cents for the given time, at the given rate per cent., and place the sum or its factors on the left; on the right, the principal and 100, or 10, 10.*

PROP. 1. What is the present worth of a note for \$1070, due 12 mo. hence, discounted at 7 per cent. per annum? *Ans.* \$1000.

OPERATION.

$$\begin{array}{r|l} 12 & 1 \\ & 12 \\ \hline & 7 \times 1 = 7 \text{ cents.} \end{array}$$

NOTE.—We see that \$1 at 7 per cent. is worth \$1.07; this is added to 100, = 107, which goes on the left; the principal, \$1070, with 100, on the right. We then reason thus: "If 107 cents, on the left, will give 100 cents, on

the right, what will the principal, \$1070, on the right, give?" Thus:

$$\begin{array}{r|l} 107 & 100 \times 10 = \$1000. \\ & 1070 \end{array}$$

2. What is the present worth of a note for \$228, due 2 years hence, at 7 per cent.?

Ans. \$200.

NOTE.—Here we see that in 2 years \$1 at 7 per cent. is worth 14 cents. This added to 100 = 114, on the left, as a divisor.

3. Capt. C. F. Hill, of Oglethorpe, Ga., gives me his note for \$640.80, due 16 mo. hence; what is the present worth of said note, discounted at 6 per cent. ? *Ans.* \$593.33 $\frac{1}{3}$.

NOTE.—To get the discount, subtract the present worth from the principal.

4. What is the discount of \$3216, due 1 mo. 6 da. hence, at 5 per cent.?

Ans. Present worth, \$3200; discount, \$16.

To Find the Percentage on any Sum or Number at any Rate per cent.

RULE 27. *Place the principal (or sum) and the rate per cent. on the right; on the left, 100, or 10, 10.*

PROP. 1. What is 8 per cent. of \$200?

Ans. \$16.

OPERATION.

$$\begin{array}{r|l} 100 & 200 \\ & 8 \times 2 = 16. \end{array}$$

NOTE.—If 100 cents, on the left, will give 8 cents, on the right, what will \$200, on the right, give? In all propositions in percentage the 100 equals the number of cents in \$1, and the 12 equals the number of months in a year.

2. Messrs. B. K. Arthur & Son, of Shellman, Ga., bought 1000 bu. of oats, and sold 60 per cent. of the lot; how many bushels were sold?

Ans. 600 bu.

3. What is $16\frac{2}{3}$ per cent. of \$18 $\frac{3}{4}$?

Ans. \$3.12 $\frac{1}{2}$.

4. What is $18\frac{3}{4}$ per cent. of \$333 $\frac{1}{3}$?

Ans. \$62.50.

5. What is $33\frac{1}{3}$ per cent. of \$33 $\frac{1}{3}$?

Ans. \$11 $\frac{1}{9}$.

6. Troup Amos has a note on B for \$1000; B agrees to pay $33\frac{1}{3}$ per cent. of it in 12 mo., $33\frac{1}{3}$ per cent. of the remainder in 24 mo.; what did B pay each year, not allowing interest?

Ans. 1st yr., \$333.33 $\frac{1}{3}$; 2d yr., \$222.22 $\frac{2}{9}$; total, \$555.55 $\frac{6}{9}$.

7. What is $37\frac{1}{2}$ per cent. of \$750?

Ans. \$281 $\frac{1}{4}$.

Having the Principal, the Time and the Amount Gained, to Find the Rate per cent.

RULE 28. *Place the principal and the time, in months, on the left; on the right, the amount gained, with 100, 12.*

PROP. 1. I gave William G. Bateman, of Butler, Ga., \$48 for the use of \$600 for 1 yr.; what was the rate per cent. ? *Ans.* 8 per cent.

OPERATION.

$$\begin{array}{r|l} 600 & 48 = 8 \text{ per ct.} \\ 12 & 100 \\ 6 & 12 \end{array}$$

NOTE.—We say, “If \$600 in 12 mo., on the left, will gain \$48, on the right, what will \$100 gain in 12 mo.?”

2. A paid B \$48 for the use of \$600 for 8 mo.; what was the rate per cent. ?

Ans. 12 per cent.

3. Wesley Hill paid \$8.82 for the use of \$72 for 1 yr. 9 mo.; what was the rate per cent. ?

Ans. 7 per cent.

NOTE.—When figures are used for cents on one side of the line, ciphers must be used on the other.

4. A agreed to pay B the sum of \$5 for the use of \$25 for 3 mo.; what was the rate per cent. ?

Ans. 80 per cent.

5. I paid on \$350, for 20 days, \$3.50 ; what was the rate per cent. ? *Ans.* 18 per cent.

NOTE.—When days are expressed for time, aliquot part of a month must be used or taken. 10 da. = $\frac{1}{3}$ mo. ; 15 da. = $\frac{1}{2}$ mo. ; 20 da. = $\frac{2}{3}$ mo., etc.

Having the Principal, the Rate per Cent. and the Amount Gained, to Find the Time.

RULE 29. *On the left place the principal and the rate per cent. ; on the right, the amount gained, with 100, 12.*

PROP. 1. How long must \$140 be on interest at 6 per cent. to gain \$42 ? *Ans.* 60 mo.

OPERATION.

$$\begin{array}{r|l} 140 & 42 \quad 7 \\ 6 & 100 \\ 20 & 12 \times 5 = 60 \text{ mo.} \end{array}$$

NOTE.—If 100 cents will gain in 12 months 6 cents, how long will it take \$140 to gain \$42 ? If the time is desired in years, place an extra 12 on the left.

2. Prof. Howard W. Key, of Cuthbert, Ga., loaned me \$500 and owes me \$45 ; how long should I use the \$500 at 9 per cent. to get. the worth of the \$45 ? *Ans.* 12 mo.

3. If I advance B \$35 as interest on \$500 at 10 per cent., how long am I to use it to get the worth of \$35? *Ans.* $8\frac{2}{5}$ mo.

4. C. A. J. Pope advanced \$18.50 for the use of \$185 at $12\frac{1}{2}$ per cent.; how long should he use the money? *Ans.* $9\frac{3}{5}$ mo.

5. I advance \$180 for the use of \$1800 at 12 per cent.; how long can I use it for the \$180? *Ans.* 10 mo.

Having the Time, the Rate per cent. and the Amount Gained, to Find the Principal.

RULE 30. Place on the right the amount gained and 100, 12; on the left, the rate per cent. and the given time, in months.

PROP. 1. What principal at 7 per cent. would be required to draw \$700 in 12 mo.?

Ans. \$10,000.

OPERATION.

$$\begin{array}{r|l} 7 & 700 \\ 12 & 100 \times 100 = 10,000. \\ & 12 \end{array}$$

NOTE.—If in 12 months 100 cents will gain the given per cent., what principal will be required to draw the given amount in the given time?

2. What principal at 10 per cent. would draw \$1000 in 20 mo.? *Ans.* \$6000.

3. How much capital at 2 per cent. per annum would be required to draw \$30,000 in 30 yr., or 360 mo. ? *Ans.* \$50,000.

4. A left his son an estate that at 7 per cent. paid him annually (every 12 mo.) \$1200 ; what was the estate worth ? *Ans.* \$17,142.85 $\frac{5}{7}$.

5. What principal at 6 per cent. per annum would be required to draw \$33,333.33 $\frac{1}{3}$ in 12 mo. ? *Ans.* \$200,000,000.

6. What principal at 9 per cent. will gain \$84 in 1 yr. 9 mo. ? *Ans.* \$560.

Profit and Loss.

Having the cost and the selling-price of an article, to find the gain or loss per cent.

RULE 31. *Place the cost on the left ; on the right, the difference (between cost and selling-price) and 100.*

PROP. 1. I bought goods at 8 cts. per yd., and sold them at 10 cts. per yd. ; what was the gain per cent. ? *Ans.* 25 per cent.

OPERATION.

$$\begin{array}{r|l} 8 & 2 \\ 4 & 100 = 25. \end{array}$$

NOTE.—If 8 cents, on the left, will gain 2 cents, on the right, what would 100 cents, on the right, gain ? The above rule covers “Profit and Loss,” and is simple.

2. We bought tobacco at 75 cts. per lb., and sold the same at \$1.00 per lb.; what was the gain per cent. ? *Ans.* $33\frac{1}{3}$ per cent.

3. We bought tobacco at \$1.00 per lb., and, being damaged, we sold it at 75 cts. per lb.; what was the loss per cent. ? *Ans.* 25 per cent.

4. Bought bacon at 10 cts. per lb., and sold it at $12\frac{1}{2}$ cts.; what was the gain per cent. ? *Ans.* 25 per cent.

5. Mr. Isaac Early bought a quantity of sugar at $12\frac{1}{2}$ cts. per lb.; he found it damaged, and sold it at $9\frac{1}{2}$ cts.; what was his loss per cent. ? *Ans.* 24 per cent.

6. Bought candy at $6\frac{1}{4}$ cts. per lb., and sold it at $18\frac{3}{4}$ cts.; what per cent. was gained ? *Ans.* 200 per cent.

Having the Cash- and the Credit-Price of an Article, to Find the Gain per cent.

RULE 32. Place the cash-price and the given time, in months, on the left; on the right, the difference (between cash-price and credit-price), with 100, 12.

PROP. 1. A sells his meat at 8 cts. per lb.

cash, but on 4 mo. time he charges 10 cts. per lb. ; what is the per cent. per annum ?

Ans. 75 per cent.

NOTE.—We say, “If 8 cents in 4 months, on the left, will gain A 2 cents, what would 100 cents gain him in 12 months?” *Ans.* 75 (which will ruin any poor farmer).

2. Ed McDonald asks for a horse \$90 in cash, but on 3 mo. time he asks \$100 ; what is the rate per cent. per annum ?

Ans. $44\frac{4}{9}$ per cent.?

NOTE.—Rule 32 is a very important one to those who are so unfortunate as to be obliged to purchase on time. Not one planter in ten ever thinks what per cent. he is paying for the time given.

3. Flour is selling for cash at \$6 per barrel ; on 3 mo. time, \$8 per barrel is charged ; what is the per cent. per annum ?

Ans. $133\frac{1}{3}$ per cent.

4. Prints are worth 5 cts. cash ; on 6 mo. time the price is $6\frac{1}{4}$ cts. ; what is the per cent. ?

Ans. 50 per cent.

5. Tobacco is worth 50 cts. per lb. cash ; on 8 mo. time it is worth $62\frac{1}{2}$ cts. ; what is the rate per cent. per annum ? *Ans.* $37\frac{1}{2}$ per cent.

Having the Cost of an Article, to Find how it should be Sold to Gain any given per cent.

RULE 33. *Add the desired per cent. to 100, and place the total on the right, also the cost ; on the left, 100.*

PROP. 1. Bought goods at 10 cts. per yard ; what must we price them at to gain 20 per cent.?

Ans. 12 cts. per yd.

OPERATION.

$$\begin{array}{r|l} 10 & 120 = 12. \\ 100 & 10 \end{array}$$

NOTE.—If 100 cents, on the left, will give 120 cents, on the right, what will the cost, 10 cents, give ?

2. Bought goods at 20 cts. per yard ; how should I price them to gain 40 per cent.?

Ans. 28 cts.

3. We bought carpeting at 50 cts. per yard ; for how much per yard must it be sold to gain $33\frac{1}{3}$ per cent.?

Ans. $66\frac{2}{3}$ cts.

4. Bought candy at $18\frac{3}{4}$ cts. per lb. ; what must be the selling-price to gain $33\frac{1}{3}$ per cent.?

Ans. 25 cts.

5. Bought a horse for \$90 ; what must be the selling-price to gain $33\frac{1}{3}$ per cent.?

Ans. \$120.

6. Bought shoes at $\$1.62\frac{1}{2}$ per pair; what must I price them at to gain $12\frac{1}{2}$ per cent.?

Ans. $\$1.82\frac{1}{6}$ cts.

To Arrive at the Average Cost of a Nest of
Tubs, Trays, Trunks, etc.

RULE 34. *Divide the cost of the nest by the sum of all the vessels.*

PROP. 1. We bought a nest of 6 trunks for \$5.04; what was the cost of each, beginning at the least?

OPERATION.

1	$1 \times 24 =$	24 cts.
2	$2 \times 24 =$	48
3	$3 \times 24 =$	72
4	$4 \times 24 =$	96
5	$5 \times 24 =$	1.20
6	$6 \times 24 =$	1.44
Sum = 21	5.04(24 cts.	\$5.04
	42	
	84	
	84	

NOTE.—The quotient, after dividing the cost by the sum, will equal the cost of the first; this, multiplied by the size in rotation, will give the cost of each in proportion to size.

2. F. M. Alison bought a nest of 9 tubs for \$4.50; what was the cost of each tub in proportion to the size?

OPERATION.

1	$1 \times 10 = 10$ cts.
2	$2 \times 10 = 20$
3	$3 \times 10 = 30$
4	$4 \times 10 = 40$
5	$5 \times 10 = 50$
6	$6 \times 10 = 60$
7	$7 \times 10 = 70$
8	$8 \times 10 = 80$
9	$9 \times 10 = 90$
Sum = 45)	4.50

3. J. W. Stanford bought a nest of 6 dishes at \$4; what did each dish cost in proportion to size?

OPERATION.

1	21)400($19\frac{1}{21}$	$19\frac{1}{21} \times 1 = 19\frac{1}{21}$
2	<u>21</u>	$19\frac{1}{21} \times 2 = 38\frac{2}{21}$
3	190	$19\frac{1}{21} \times 3 = 57\frac{3}{21}$
4	<u>189</u>	$19\frac{1}{21} \times 4 = 76\frac{4}{21}$ Fractions
5	$\frac{1}{21}$	$19\frac{1}{21} \times 5 = 95\frac{5}{21} = 1.$
6		$19\frac{1}{21} \times 6 = 114\frac{6}{21}$
21		<u>\$4.00</u>

Cause and Effect.

NOTE.—The whole science of numbers may be embraced under the above principle—"Cause and Effect"—and under this is worked by proportion; and where there is no proportion, there is no mathematics. Common sense teaches us that wherever there be a cause there must be an effect, and in my long experience as a teacher of mathematics I have found that under this principle I can im-

part instruction with much more ease than under any other. Indeed, it is common-sense analysis, and is appreciated by all when understood. In my *Common-Sense Arithmetic* (brought out in 1882) the principle is, I think, fully explained, and by it may be easily understood. We now propose working a few propositions under the above heading, which we think will explain itself.

PROP. 1. If 10 bundles of fodder weigh 20 lbs., what will 400 bundles weigh?

Ans. 800 lbs.

DIAGRAM FOR MAKING STATEMENT.

1st cause.	1st effect.
10	20
2d effect.	2d cause.
	$400 \times 2 = 800.$

NOTE.—In this we see that 10 bundles of fodder is the 1st cause, and 20 lbs. the 1st effect. Then, what would be the effect of 400 bundles under the 2d cause?

2. If 7 hats cost \$28, what would be the cost of 11 hats? \$44.

NOTE.—Here 7 hats is the 1st cause, \$28 the 1st effect. Then, what would be the effect of 11 hats?

3. If 4 yd. of cloth cost \$16, what would 5 yd. cost? Ans. \$20.

OPERATION.

4	16
	$5 \times 4 = 20.$

4. If 5 yd. of cloth cost \$20, what would 4 yd. cost? *Ans.* \$16.

NOTE.—Simple causes produce simple effects, compound causes like effects, and for the proof reverse the operation, as in Propositions 3 and 4.

5. If 7 horses in 4 da. consume 28 bu. of oats, how long will it take 5 horses to consume 60 bu.? *Ans.* 12 da.

OPERATION.

7 4	28
60 12	5

NOTE.—In this we see that 7 horses and 4 da. are the 1st cause, 28 bu. the 1st effect; 5 horses the 2d cause, and 60 bu. the 2d effect. Causes are placed opposite causes, effects opposite effects, and there will always be a blank term, sometimes on the right, sometimes on the left. If on the left, the answer will be on the right; but if the blank term be on the right, the answer will be on the left.

6. If 36 men, working 9 hr. each day for 4 da., dig a ditch 240 ft. long, 8 ft. wide and 6 ft. deep, what would be the depth of a ditch, 60 ft. long and 6 ft. wide, dug by 9 men in 3 da., working 6 hours per da.? *Ans.* 4 ft.

OPERATION.

36	240 4	
3 9	8	
2 4	6 2 = 4 ft.	
60	9	
6	3	
	6	

NOTE.—Here we see that 36 men, working 9 hr. a day for 4 da., gives a cause; a ditch 240 ft. long, 8 ft. wide and 6 ft. deep the effect. Then the 2d cause is 9 men in 3 da., working 6 hours per day, to give the 2d effect, which is a ditch 60 ft. long and 6 ft. wide. The depth is a blank which is on the left; hence the answer is on the right.

7. If 8 cats eat 8 rats in 8 min., how many cats will it take to eat 400 rats in 200 min.?

Ans. 16 cats.

PROOF.—If 16 cats in 200 min. eat 400 rats, how many cats in 8 min. will eat 8 rats?

Ans. 8 cats.

8. If 8 horses in 52 da. eat 416 bu. of oats, how many bushels will 26 mules eat in 30 da., each mule eating $\frac{5}{13}$ as much as a horse?

Ans. 300 bu.

9. Col. McLendon, of Thomasville, contracts to grade 24 miles of railroad in 8 mo.; for this he employs 150 men, who work 5 mo. and complete only 10 miles of the road; how many more men must be employed to finish the road in the time agreed on?

Ans. 200.

OPERATION.

$$\begin{array}{r|l}
 15 & 150 \\
 5 & \\
 \hline
 14 & 3 \\
 5 & \\
 \hline
 70 & \\
 5 & \\
 \hline
 350 &
 \end{array}$$

NOTE.—It will be seen that 150 men in 5 mo. build only 10 miles; he then had 3 mo. more to work on, and 14 miles to grade. Then, if 150 men in 5 mo., as a cause, build 10 miles, the effect, how many men in 3 mo. (2d cause) will be required to build 14 miles (2d effect) in 3 mo. (2d cause)?

Ans. 350 men. But he has already 150, so 150 men from 350 men leave 200 more men.

(The next two propositions I take from Prof. Caldwell's noble work.)

10. If in 6 da. $17\frac{1}{3}$ hours long 16 men with 13 mules can cut 312 yd. in length, $15\frac{1}{3}$ yd. in width and $8\frac{2}{3}$ ft. deep, how many mules will be required with 6 men in $3\frac{3}{5}$ days of $16\frac{11}{12}$ hours long to perform another excavation, $50\frac{3}{4}$ yd. long, $10\frac{4}{5}$ yd. wide and $15\frac{1}{3}$ ft. deep?

Ans. 12 mules.

NOTE.—All mixed numbers must be reduced to improper fractions, placing the numerators where the mixed numbers occur, with its denominator on the opposite side.

OPERATION.

6	312		6	312 6
17 $\frac{1}{3}$	15 $\frac{1}{3}$	17 $\frac{1}{3}$ = 2	~~52~~	~~3~~ 3
16	8 $\frac{2}{3}$		4 16	46
13			13	26 2
			3 3	
50 $\frac{3}{4}$	6		203	6
10 $\frac{4}{5}$	3 $\frac{3}{5}$		5	18
15 $\frac{1}{3}$	16 $\frac{1}{12}$		12	203
			3 54	4
			46	5
				3

NOTE.—All numbers are canceled out but 12, under the 2d cause, which = Ans. 12 mules.

11. If 112 men in 11 da. of 11 hours each dig a trench of 7° of hardness, 232 $\frac{1}{2}$ ft. long, 3 $\frac{2}{3}$ ft. wide and 2 $\frac{1}{2}$ ft. deep, in how many days of 5 $\frac{1}{2}$ hours long will 56 men dig a trench of 5° of hardness, 465 ft. long, 5 $\frac{3}{5}$ ft. wide and 3 $\frac{1}{2}$ ft. deep? *Ans.* 144 days.

12. If 3 compositors in 16 da. of 14 hours each can set 20 sheets of 24 pages each, 50 lines in a page and 40 letters in a line, in how many days of 7 hours each will 10 compositors set a volume, to be printed in the same type, containing 40 sheets, 16 pages in a sheet, 60 lines in a page and 50 letters in a line?

Ans. 32 days.

13. If 33 ft. of 8-in. belting, 4-ply, cost \$9,

how many feet of 6-in. belting, 3-ply, can be bought for the same amount? *Ans.* $58\frac{2}{3}$ ft.

PROOF.—If $58\frac{2}{3}$ ft. of 6-in. belting, 3-ply, will cost \$9, how many feet of 8-in. belting, 4-ply, will cost the same?
Ans. 33 ft.

12. If 10 men in 24 da. make 120 pairs of shoes, how many men in 15 da. will it take to make 600 pairs? *Ans.* 80 men.

PROOF.—If 80 men in 15 da. make 600 pairs of shoes, how many men in 24 da. will it take to make 120 pairs?
Ans. 10 men.

Partnership.

Partnership is an association formed between two or more individuals for business purposes. The profits or the losses are divided among them, and each partner's stock is employed for the same time as that of the others. Problems in Partnership are solved by the principle of cause and effect, under the following rule:

RULE 35. *Find the total amount invested, and place the aggregate under the first cause; under the 1st effect place the gain or the loss; under the 2d cause A's stock, then B's, etc., making a statement for each.*

PROP. 1. Sandlin, Fulton & Helms bought a lot of land for \$1500, and sold the same at a gain of \$300. Helms put in \$400; Fulton, \$500; Sandlin, \$600. What was the share of each in the gain?

Ans. Helms, \$80; Fulton, \$100; Sandlin, \$120.

OPERATION.

Helms.		Fulton.		Sandlin.	
1500	300	1500	300	1500	300
5					
	400 = \$80.	5	500 = \$100.	5	600 = \$120.

NOTE.—We find the total amount of the investment to be \$1500. Then, if the sum \$1500, as the 1st cause, will gain \$300, the 1st effect, what will Helms's \$400 gain? *Ans.* \$80. Again, if \$1500 will gain \$300, what will Fulton's \$500 gain? *Ans.* \$100. If \$1500 will gain \$300, what will Sandlin's \$600 gain? *Ans.* \$120.

$$\$120 + \$100 + \$80 = \$300.$$

2. A and B engage in trade. A's capital was \$200; B's, \$300. They gained \$1000; what was each one's share of the gain?

Ans. A's, \$400; B's, \$600.

3. James Baisden, John Watts and Goode Jordan carried to market 24 bu. of peas, for which they received \$24. Baisden put in $\frac{1}{2}$ of

the peas; Watts, $\frac{1}{3}$; Jordan, $\frac{1}{4}$; to how much of the receipts was each entitled?

Ans. Baisden, $\$11\frac{1}{13}$; Watts, $\$7\frac{5}{13}$; Jordan, $\$5\frac{7}{13}$.

NOTE.—In the solution of such propositions we must add together the fractions, which in the above form more than the unit ($=\frac{1\frac{3}{2}}$), which gives a cause. Then, if $\frac{1\frac{3}{2}}$, as the 1st cause, will produce \$24, the first effect, what would $\frac{1}{2}$ produce? $\frac{1}{3}$? $\frac{1}{4}$? etc.

OPERATION.

$$\begin{array}{r|l} & \text{Baisden.} \\ 13 & 12 \times 12 = 144 \div 13 = \$11\frac{1}{13} \\ & \cancel{24} \\ \hline 2 & 1 \end{array}$$

$$\begin{array}{r|l} & \text{Watts.} \\ 13 & 12 \times 8 = 96 \div 13 = \$7\frac{5}{13} \\ & \cancel{24} \\ \hline 3 & 1 \end{array}$$

$$\begin{array}{r|l} & \text{Jordan.} \\ 13 & 12 \times 6 = 72 \div 13 = \$5\frac{7}{13} \\ & \cancel{24} \\ \hline 4 & 1 \end{array}$$

4. A gentleman divided his estate among his three children, John, William and Mary. To John he gave $\frac{1}{2}$; to William, $\frac{1}{3}$; to Mary, $\frac{1}{9}$.

His estate consisted of 17 elephants. What was the share of each?

Ans. John, 9; William, 6; Mary, 2, = 17.

NOTE.—Partners share and share alike in their gains, also in losses; so in the above $\frac{1}{2} + \frac{1}{3} + \frac{1}{9}$ fail to equal the unit, as it is equal only to $\frac{17}{18}$. Then, if $\frac{17}{18}$, as a cause, equal the whole number, 17, what will $\frac{1}{2}$ be? 9. Again, if $\frac{17}{18} = 17$, what will $\frac{1}{3}$ equal? 6. Again, if $\frac{17}{18} = 17$, what will $\frac{1}{9}$ equal? 2.

5. A, B and C purchased goods to the amount of \$150, and gained \$60. A paid \$40; B, \$50; C, \$60. What was the gain of each?

Ans. A, \$16; B, \$20; C, \$24.

Barter.

Barter is the exchange of one commodity for another, and the operation is simplified by cause and effect.

RULE 36. *Under the 1st cause place the price of the desired quantity; under the 1st effect, the given quantity; under the 2d cause, its price.*

PROP. 1. How many pounds of raisins at 10 cts. per pound must be given for 50 lbs. of candy at 18 cts. per pound? *Ans.* 90 lbs.

OPERATION.

$$\begin{array}{r|l} 10 & 18 \times 5 = 90. \\ \hline & 50 \end{array}$$

NOTE.—If 10 cts., as the 1st cause, will give 18 cts., the 1st effect, what will 50 lbs., under 2d cause, produce?

2. What number of yards of jeans at 80 cts. per yard is equal to 60 yd. of cassimere at 80 cts. per yard? *Ans.* 60 yd.

3. How many yards of goods at $18\frac{3}{4}$ cts. per yard can I get for $18\frac{3}{4}$ doz. eggs at $6\frac{1}{4}$ cts. per dozen? *Ans.* $56\frac{1}{4}$ yd.

4. What number of yards of goods at 80 cts. per yard is equal to 60 yd. of other goods at 80 cts. per yard? *Ans.* 60 yd.

5. How many bushels of corn at 80 cts. per bushel is equal to 320 bu. of wheat at \$1.60 per bushel? *Ans.* 640 bu.

Averaging the Price of Cotton or any other Commodity.

RULE 37. *Place the total number of pounds, bushels, etc., or the factors, on the left; on the right, the total cost, in dollars and cents.*

PROP. 1. Col. Cutts, of Americus, Ga., bought cotton as follows:

5000	lbs.	at	9	cts.	per.	lb.	=	\$450.00
2500	"		10		"		=	250.00
3000	"		11		"		=	330.00
500	"		12		"		=	60.00
11000								\$1090.00

OPERATION.

$$\begin{array}{r|l} 11000 & 1090.00 \\ & 9\frac{10}{11}. \end{array}$$

What is the average cost?

Ans. $9\frac{10}{11}$ cts.

2. Bought cotton as follows:

1050	lbs.	at	$7\frac{1}{2}$	cts.
2150	"		$8\frac{1}{4}$	"
800	"		$10\frac{1}{2}$	"

What is the average price per pound for the above bill?

Ans. $8\frac{81}{20}$ cts.

3. Bought the following bill of tobacco:

150	lbs.	at	$16\frac{2}{3}$	cts.	per	lb
100	"		$33\frac{1}{3}$		"	
250	"		$62\frac{1}{2}$		"	

What was the average cost of the bill per pound?

Ans. $42\frac{11}{12}$ cts.

4. T. R. Bloom, of Macon, Ga., bought cotton as follows :

3700	lbs.	at	8	cts.	per	lb.
6500		"	9		"	
50000		"	$9\frac{1}{2}$		"	
1700		"	11		"	
2900		"	$12\frac{1}{2}$		"	

What was the average cost per pound ?

Ans. $9\frac{497}{1296}$.

To Find the Capacity of a Tank in Gallons.

RULE 38. *Place the length, the width and the depth, in feet, with 1728, on the right ; on the left, 231, or its factors, 3, 7, 11.*

PROP. 1. The C. R. R. tank at Graves Station is said to be 22 ft. long, 7 ft. wide and 6 ft. deep ; how many gallons of water will it contain ?

Ans. 6912 gal.

OPERATION.

$$\begin{array}{r|l}
 3 & 22 \\
 7 & 7 \\
 11 & 6 \\
 \hline
 & 1728 \times 2 \times 2 = 6912.
 \end{array}$$

NOTE.—The length, the width and the depth, in feet, on the right, with 1728, reduce the tank to cubic inches, and 231, or 3, 7, 11, equals the number of gallons.

2. Harper Black's tan-vats being 7 ft. long, $5\frac{1}{2}$ ft. wide and $3\frac{1}{2}$ ft. deep, how many gallons of water will each contain? *Ans.* 864 gals.

To Find the Capacity of a Round Tank in Gallons.

RULE 39. *Place twice the inside diameter, in inches, with its depth, in inches, and 11, on the right; on the left, 231, 2, 7, or 2, 7, 3, 11, 7.*

PROP. 1. Dr. J. W. Stanford's oil-tank is 22 in. in diameter and 35 in. deep; how many gallons of oil will it contain? *Ans.* $57\frac{1}{2}\frac{3}{1}$ gal.

OPERATION.

$$\begin{array}{r|l}
 2 & 22 \\
 7 & 22 \\
 3 & 35 \\
 7 & 11 \\
 11 &
 \end{array}
 \quad 11 \times 5 \times 22 = 1210 \div 21 = \text{Ans.}$$

NOTE.—The latter 3, 7, 11 are factors of 231, the number of cubic inches in 1 gallon. The above rule is worked on the same principle as Rule 48, etc.

Having the Length, to Find how much Land to cut off to give any Desired Number of Acres.

RULE 40. *Place the given length of the land, in yards, on the left; on the right, the desired number of acres and 11, 11, 10, 4.*

PROP. 1. We have a field 880 yd. long, and I rent to a tenant 8 A.; how far will I have to go to get the 8 acres?

OPERATION.

$$\begin{array}{r|l}
 & 8 \\
 880 & 11 \\
 80 & 11 \\
 & 10 \\
 & 4 \times 11 = 44 \text{ yd.}
 \end{array}
 \qquad \text{Ans. 44 yd.}$$

2. How far would we go across a field 550 yd. in length to get 11 A.? Ans. $96\frac{4}{5}$ yd.

3. How far would we have to go across a lot of land 990 yd. in length to get 45 A.?

Ans. 220 yd.

4. A lot of land 1100 yd. square contains 250 A., but I sell my neighbor 75 A. on the south side of the lot; how wide a piece of land 1100 yd. long will be required to produce the 75 A.?

Ans. 330 yd.

Having the Length in Yards, to Find the Width required for One Acre of Land in Yards.

RULE 41. *Place the length of the field, in yards, on the left; on the right, 11, 11, 10, 4.*

PROP. 1. Suppose a field to be 440 yd. long; how wide a strip of land will be required for 1 A.?

Ans. 11 yd.

OPERATION.

$$\begin{array}{r|l}
 440 & 11 \\
 44 & 11 \\
 4 & 10 \\
 & 4
 \end{array}$$

NOTE.—As 4840 sq. yd. = 1 A., we divide by the length, which equals the width required.

2. W. J. Oliver has a field 550 yd. in length ; how wide a strip is required for 1 A. ?

Ans. $8\frac{4}{5}$ yd., or 26 ft. $8\frac{4}{5}$ in.

3. We have a tract of land just 1 mi. (or 1760 yd.) in length ; how wide a strip across this tract would be required for 1 A. ?

Ans. $2\frac{3}{4}$ yd.

4. A owns a small patch of land 80 yd. in length ; what width would be required to equal 1 A. across this patch ?

Ans. $60\frac{1}{2}$ yd.

5. My neighbor John Mathews has a field 220 yd. in length ; how many rows 3 ft. apart would be required to equal 1 A. ?

Ans. 22 yd., or 22 rows.

An Easy and Quick Process for Multiplying any Number by the Aliquot Part of 100.

RULE 42. *If it is desired to multiply any number by $6\frac{1}{4}$, annex two ciphers to the multiplicand and divide by 16 or by its factors, because $6\frac{1}{4}$ is equal to $\frac{1}{16}$ of 100.*

PROP. 1. Multiply 64 by $6\frac{1}{4}$. *Ans.* 400.

To multiply any number by $12\frac{1}{2}$: Annex two ciphers and divide by 8, because $12\frac{1}{2} = \frac{1}{8}$ of 100.

To multiply by $16\frac{2}{3}$: Annex two ciphers and divide by 6, because $16\frac{2}{3} = \frac{1}{6}$ of 100.

To multiply by 25: Annex two ciphers and divide by 4, because $25 = \frac{1}{4}$ of 100.

To multiply by $33\frac{1}{3}$: Annex two ciphers and divide by 3, because $33\frac{1}{3} = \frac{1}{3}$ of 100.

To multiply by $37\frac{1}{2}$: Annex two ciphers and place the sum and 3 on the right and 8 on the left, because $37\frac{1}{2} = \frac{3}{8}$ of 100.

To multiply by $62\frac{1}{2}$: Annex two ciphers and place the sum on the right, with 5; on the left, 8.

To multiply by $87\frac{1}{2}$: Annex two ciphers and place the sum on the right, with 7; on the left, 8.

To multiply any number by 75: Annex two ciphers and place the sum on the right, with 3; on the left, 4.

MENSURATION.

The following geometrical rules are offered for the convenience of finding areas, etc., and will be found very nearly correct—that is, for all practical purposes. As for reasons, the student will have to search them out in the higher branches, without a knowledge of which he would fail to comprehend them were we to consume space in giving them.

Having the Diameter of a Circle, to Find its Area.

RULE 43. *Place the diameter twice, with 11, on the right; on the left, 2 and 7.*

PROP. 1. What is the area of a circle 28 ft. in diameter? *Ans.* 616 sq. ft.

OPERATION.

$$\begin{array}{r} 2 \quad 28 \\ 7 \quad 28 \\ \hline 11 \times 4 \times 14 = 616. \end{array}$$

NOTE.— $\frac{1}{14}$ = the unit; $\frac{3}{14}$ is taken up from the square for the 4 chords and the 4 arcs, $= \frac{1}{14}$; hence the square, multiplied by $\frac{1}{14}$, = its area. If you work in inches, the result will be square inches; if in feet, square feet; if in yards, square yards; if in miles, square miles.

2. We have a circle 63 yd. in diameter; what is its area in square yards? *Ans.* $3118\frac{1}{2}$ sq. yd.

3. We have a circular garden 140 yd. in diameter; what is its area in square yards and square acres? *Ans.* 15400 sq. yd., or $3\frac{22}{121}$ A.

NOTE.—When the area in acres is asked for, divide the result by 4840, or place 11, 11, 10, 4 extra on left—that is, for yards. If rods, put 4, 10, 4 on the left, extra; if in chains, put 10 extra on the left, etc.

4. The city of Dawson is incorporated 1 m. each way from the court-house; how many acres are included in the corporate limits?

NOTE.—We find that the corporate limits contain $3\frac{1}{2}$ sq. m., and as 1 m. = 640 A. the $3\frac{1}{2}$ equal the answer. In miles put 640 extra, on the right, to get the result in acres.

Having the Circumference of a Circle, to Find its Area.

RULE 44. *Place the circumference twice and 7 on the right; on the left, 8, 11.*

PROP. 1. A lake is 880 yd. in circumference; what is its area in square yards?

Ans. 61600 sq. yd.

2. Lake Defeniak, in Florida, is 1 m., or 1760 yd., in circumference; what is its area in acres?

Ans. $50\frac{10}{11}$ A.

OPERATION.

$$\begin{array}{r|l}
 8 & 1760 \ 160 \\
 2 \ 11 & 1760 \\
 11 & 7 \times 80 = 560 \div 11 = \text{Ans.} \\
 10 & 176 \\
 11 & 44 \\
 4 & 4
 \end{array}$$

NOTE.—As the circumference is considered in yards, we place on the left 11, 11, 10, 4, besides 8, 11, which gives the result in acres. Had we worked in miles, we would have followed the rule for miles and put 640 extra for acres on the right.

SECOND OPERATION.

$$\begin{array}{r|l}
 8 & 1 \\
 11 & 1 \\
 & 7 \\
 \hline
 640 & 80 \times 7 = 560 \div 11 = \text{the same result, } 50\frac{10}{11} \text{ A.}
 \end{array}$$

3. How many square feet in a circle whose outside measurement is 88 ft. ?

Ans. 616 sq. ft.

4. George Johnson has a meadow whose fencing measures 110 yd.; how many acres does it contain ?

Ans. $\frac{35}{176}$ A.

To Find the Area of a Globe or a Ball.

RULE 45. *On the right place the diameter twice and 22; on the left, 7.*

PROP. 1. What is the area of a globe 14 in. in diameter ?

Ans. 616 sq. in.

OPERATION.

$$\begin{array}{r|l}
 7 & 14 \\
 & 14 \\
 \hline
 & 22 \times 2 \times 14 = 616.
 \end{array}$$

NOTE.—If the diameter be in inches, the result will be square inches; if in feet, square feet.

2. How many square feet on the surface of a globe or ball $3\frac{1}{2}$ ft. in diameter?

Ans. $38\frac{1}{2}$ sq. ft.

3. What is the area of a globe $10\frac{1}{2}$ ft. in diameter?

Ans. $346\frac{1}{2}$ sq. ft.

To Find the Solidity of a Globe or a Ball.

RULE 46. *Place the diameter thrice, with 11, on the right; on the left, 3, 7.*

PROP. 1. How many solid inches in a ball 21 in. in diameter? *Ans.* 4851 sol. in.

OPERATION.

$$\begin{array}{r|l}
 3 & 21 \\
 7 & 21 \times 21 \times 11 = 4851. \\
 & 21 \\
 & 11
 \end{array}$$

NOTE.—In solids, length, breadth and depth are considered; hence the cube, etc. Inches produce inches; feet produce feet; yards produce yards.

2. We have a base-ball $3\frac{1}{2}$ in. in diameter; how many solid inches in the ball?

Ans. $22\frac{11}{4}$ sol. in.

To Find the Area of the Largest Square that can be Inscribed within a Circle.

RULE 47. *Place the diameter twice on the right; on the left, 2.*

PROP. 1. What is the area of a square that can be inscribed in a circle 14 in. in diameter?

Ans. 98 sq. in.

OPERATION.

$$\begin{array}{r|l} 2 & 14 \\ & 14 \times 7 = 98. \end{array}$$

NOTE.—Multiplying the square of any diameter by $\frac{1}{2}$ will produce its area. Then, to get one of the sides, the square root of its area must be extracted. For the mode of doing this reference is made to any writer on arithmetic who treats of square root. We cannot simplify nor abbreviate either cube root or square root from the many authors who have preceded us; hence both are omitted in this manual.

2. What is the area of a square that can be inscribed in a circle 60 ft. in diameter?

Ans. 1800 sq. ft.

3. Give the area of a circle 30 in. in diameter?

Ans. 450 sq. in.

To Find the Solidity of a Cylinder.

RULE 48. *Place its diameter twice, and also its length, with 11, on the right; on the left, 2, 7.*

PROP. 1. Required the solidity of a cylinder 4 ft. in diameter and 10 ft. long.

Ans. $125\frac{5}{7}$ sol. ft.

OPERATION.

$$\begin{array}{r|l} 2 & 4 \\ 7 & 4 \\ & 10 \\ & 11 \times 2 \times 10 \times 4 = 880 \div 7 = 125\frac{5}{7}. \end{array}$$

NOTE.—If the diameter be in inches, the length must be taken in inches, and the result will be cubic inches; if feet, cubic feet.

2. What are the solid contents, in feet, of a cylinder 2 ft. in diameter and 10 ft. long?

Ans. $31\frac{3}{7}$ sol. ft.

3. How many solid feet in a screw-pin $10\frac{1}{2}$ in. in diameter and 16 ft. long?

Ans. $9\frac{5}{8}$ cu. ft.

4. At $1\frac{1}{2}$ cts. per solid inch, what would be the cost of a screw-pin $3\frac{1}{2}$ in. in diameter and 10 ft. long?

Ans. \$17.32 $\frac{1}{2}$.

NOTE.—We see that the above pin gives 1155 cu. in.; this, at $1\frac{1}{2}$ cts. per cubic inch, gives the answer.

OPERATION.

$$\begin{array}{r|l}
 2 & 7 \ 3\frac{1}{2} = \frac{7}{2} \\
 2 & 7 \ 3\frac{1}{2} = \frac{7}{2} \\
 2 & 120 \ 10 \text{ ft. long} = 120 \text{ in.} \\
 7 & 11 \ 1\frac{1}{2} \text{ cts.} = \frac{3}{2} \text{ ct.} \\
 2 & 3 \\
 & 60 \\
 & 30 \\
 & 15 \times 3 \times 11 \times 7 = 3465 \div 2 = \text{the cost.}
 \end{array}$$

6. How many cubic ft. in a round shaft $2\frac{1}{2}$ ft. in diameter and 30 ft. long?

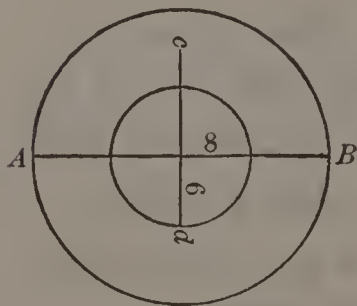
Ans. $147\frac{9}{8}$ cu. ft.

Having the Diameter of two Circles, one formed within the other, to Find the Area of the Ring.

RULE 49. *Place the sum of the diameters, with their difference and 11, on the right; on the left, 2, 7.*

PROP. 1. We have two circles, one 8 ft. in diameter, and the other 6 ft. in diameter; how many square feet between the two circles?

Ans. 22 sq. ft.



OPERATION.

$$\begin{array}{r|l}
 2 & 14 \\
 7 & 2 \\
 & 11 \\
 & \hline
 & 22 \text{ sq. ft.}
 \end{array}$$

$8 + 6 = 14$ sum of diameters.

$8 - 6 = 2$ difference in “

NOTE.—The above rule can be applied to finding the number of cubic feet of stone to wall up a round well by placing the depth of the well in feet extra on the right.

2. What is the area of a ring formed by two circles 10 and 20 yd. in diameter?

Ans. $235\frac{5}{7}$ sq. yd.

3. Col. W. H. Willis, of Oglethorpe, Ga., has a round well dug, 80 ft. deep, 7 ft. in diameter, and walled up with stone so as to leave the diameter $3\frac{1}{2}$ ft. ; how many solid feet of stone were required? *Ans.* 2310 sol. ft.

4. The C. R. R. digs a round well 80 ft. deep and 6 ft. in diameter, and walls it with stone so as to leave the opening 4 ft. in diameter ; what number of cubic feet of stone is required?

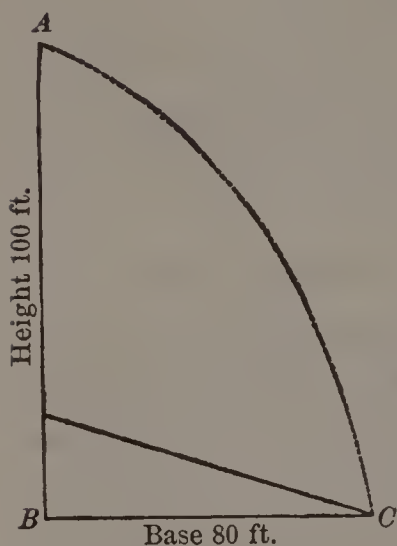
Ans. $1257\frac{1}{7}$ cu. ft.

To Find where a Pole should be Broken to Strike the Ground at any Given Distance and Hang on the Stump.

RULE 50. *Square the height of the pole, to which add the square of the base, and place the sum on the right ; on the left, the height of the pole and 2.*

PROP. 1. On a level plain stands a pole 100 ft. high; how much must break off to strike 80 ft. from the stump and hang?

Ans. 82 ft.



OPERATION.

$$\begin{array}{r|l} 100 & 16400 \\ 2 & 164 \\ & 82 \end{array}$$

$$\begin{array}{r} 100 \times 100 = 10000 \\ 80 \times 80 = \underline{6400} \\ 16400 = \end{array}$$

the sum on right. Height, 100, and 2, on left, = the divisor.

NOTE.—If the question is, How high above the ground must the pole break off? subtract the amount broken off from the height of the pole. Thus, $100 - 82 = 18$ ft. Or if you subtract the square of the base from the square of the height and divide the remainder by twice the height, this will also give the height of the stump.

2. On a level plain stands a pole 80 ft. high; at what height above the ground must it be broken to strike the ground 40 ft. from the stump and hang?

Ans. 30 ft.

3. On a level plain stands a pole 33 ft. 8 in. ($= 33\frac{2}{3}$ ft.); how much must break off to strike

the ground 20 ft. 4 in. ($= 20\frac{1}{3}$ ft.) from where it stands and hang to the stump?

Ans. $22\frac{2}{3}\frac{4}{3}$ ft.

To Measure the Distance to any Given Object.

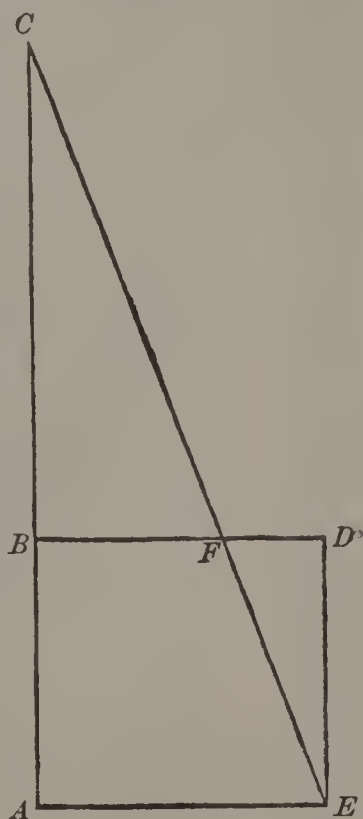
RULE 51. *Draw a right-angled triangle, A, E, D, B, 30 ft. Stand at the point E and take C for the given object, and where it crosses the line BD (at F) stick a peg; then measure the distance, in feet, from F to D, and place it, in feet, on the left, and 30, 30 on the right. This gives the distance from A to C in feet.*

PROP. 1. In the accompanying diagram we find the distance from *F* to *D* to be 2 ft.; what is the distance from *A* to *C*? *Ans.* 450 ft.

OPERATION.

$$\begin{array}{r|l} 2 & 30 \\ \hline & 30 \times 15 = 450 \text{ ft.} \end{array}$$

NOTE.—If the right angle be in yards, the result will be yards; if the angle be rods, the result will be rods. This angle must be measured accurately, and the distance from *F* to *D* must be accurate, to



obtain an accurate result. If F to D be taken in inches, $AEDB$ must be brought to inches, and then the result from A to C will be inches. To get the distance from A to C , subtract AB from AC .

2. What would be the distance from A to C if FD be 3 ft.?

Ans. 300 ft.

3. What would be the distance from A to C if FD be $2\frac{1}{2}$ ft.?

Ans. 360 ft.

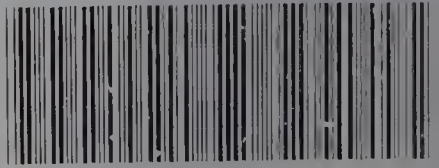
TABLE SHOWING THE NUMBER OF PLANTS ON AN ACRE OF LAND
AT ANY GIVEN DISTANCE APART.

				No. Plants.					No. Plants.
9 ft. 0 in.	by	9 ft. 0 in.		537	5 ft. 6 in.	by	4 ft. 0 in.	1980	
9 0		8 0		605	5 6		3 9	2112	
9 0		7 0		691	5 6		3 6	2262	
9 0		6 0		806	5 6		3 3	2436	
9 0		5 0		968	5 6		3 0	2640	
8 0		8 0		680	5 6		2 9	2880	
8 0		7 0		777	5 6		2 6	3168	
8 0		6 0		905	5 6		2 3	3520	
8 0		5 0		1089	5 6		2 0	3960	
8 0		4 0		1361	5 6		1 9	4525	
8 0		3 0		1815	5 6		1 6	5280	
7 0		7 0		888	5 6		1 3	6336	
7 0		6 6		957	5 6		1 0	7920	
7 0		6 0		1037	5 0		5 0	1742	
7 0		5 6		1131	5 0		4 9	1834	
7 0		5 0		1244	5 0		4 6	1936	
7 0		4 6		1382	5 0		4 3	2049	
7 0		4 0		1555	5 0		4 0	2178	
7 0		3 6		1777	5 0		3 9	2323	
7 0		8 0		2074	5 0		3 6	2489	
7 0		2 6		2489	5 0		3 3	2680	
7 0		2 0		3111	5 0		3 0	2904	
7 0		1 6		4148	5 0		2 9	3168	
7 0		1 0		6222	5 0		2 6	3484	
6 6		6 6		1031	5 0		2 3	3872	
6 6		6 0		1116	5 0		2 0	4356	
6 6		5 6		1218	5 0		1 9	4978	
6 6		5 0		1340	5 0		1 6	5808	
6 6		4 6		1489	5 0		1 3	6969	
6 6		4 0		1675	5 0		1 0	8712	
6 6		3 6		1914	4 9		4 9	1930	
6 6		3 0		2233	4 9		4 6	2037	
6 6		2 6		2680	4 9		4 3	2157	
6 6		2 0		3350	4 9		4 0	2292	
6 6		1 6		4467	4 9		3 9	2445	
6 6		1 0		6701	4 9		3 6	2620	
6 0		6 0		1210	4 9		3 3	2821	
6 0		5 9		1262	4 9		3 0	3056	
6 0		5 6		1320	4 9		2 9	3334	
6 0		5 0		1452	4 9		2 6	3668	
6 0		4 6		1613	4 9		2 3	4075	
6 0		4 0		1815	4 9		2 0	4585	
6 0		3 6		2074	4 9		1 9	5248	
6 0		3 0		2420	4 9		1 6	6113	
6 0		2 6		2904	4 9		1 3	7336	
6 0		2 0		3630	4 9		1 0	9170	
6 0		1 6		4840	4 6		4 6	2151	
6 0		1 0		7260	4 6		4 3	2277	
5 6		5 6		1417	4 6		4 0	2420	
5 6		5 3		1508	4 6		3 9	2581	
5 6		5 0		1584	4 6		3 6	2765	
5 6		4 9		1667	4 6		3 3	2978	
5 6		4 6		1760	4 6		3 0	3226	

TABLE SHOWING NUMBER OF PLANTS, Etc. (Continued).

				No. Plants.					No. Plants.
4 ft. 6 in. by 2 ft. 9 in.				3520	3 ft. 6 in. by 1 ft. 0 in.				12145
4 6 2 6				3872	3 3 3 3				4124
4 6 2 0				4840	3 3 3 0				4818
4 6 1 9				5531	3 3 2 9				4873
4 6 1 6				6453	3 3 2 6				5361
4 6 1 3				7774	3 3 2 3				5956
4 6 1 0				9680	3 3 2 0				6701
4 3 4 3				2411	3 3 1 9				7658
4 3 4 0				2562	3 3 1 6				8935
4 3 3 9				2733	3 3 1 3				10722
4 3 3 6				2914	3 3 1 0				13403
4 3 3 3				3153	3 0 3 0				4840
4 3 3 0				3416	3 0 2 9				5289
4 3 2 9				3727	3 0 2 6				5808
4 3 2 6				4099	3 0 2 3				6453
4 3 2 3				4555	3 0 2 0				7260
4 3 2 0				5124	3 0 1 9				8297
4 3 1 9				5856	3 0 1 6				9680
4 3 1 6				6832	3 0 1 3				11616
4 3 1 3				8199	3 0 1 0				14520
4 3 1 0				10249	2 9 2 9				5760
4 0 4 0				2722	2 9 2 6				6336
4 0 3 9				2904	2 9 2 3				7040
4 0 3 6				3111	2 9 2 0				7920
4 0 3 3				3350	2 9 1 9				9051
4 0 3 0				3630	2 9 1 6				10560
4 0 2 9				3960	2 9 1 3				12670
4 0 2 6				4356	2 9 1 0				15840
4 0 2 0				5445	2 6 2 6				6969
4 0 1 9				6222	2 6 2 3				7740
4 0 1 6				7260	2 6 2 0				8712
4 0 1 3				8712	2 6 1 9				9956
4 0 1 0				10890	2 6 1 6				11616
3 9 3 9				3097	2 6 1 3				13939
3 9 3 6				3318	2 6 1 0				17424
3 9 3 3				3574	2 3 2 3				8604
3 9 3 0				3872	2 3 2 0				9680
3 9 2 9				4224	2 3 1 9				11062
3 9 2 6				4646	2 3 1 6				12106
3 9 2 3				5162	2 3 1 3				15488
3 9 2 0				5808	2 3 1 0				19360
3 9 1 9				6637	2 0 2 0				10890
3 9 1 6				7744	2 0 1 9				12445
3 9 1 3				9272	2 0 1 6				14520
3 9 1 0				11616	2 0 1 3				17424
3 6 3 6				3555	2 0 1 0				21780
3 6 3 3				3829	1 9 1 9				14232
3 6 3 0				4148	1 9 1 6				16594
3 6 2 9				4525	1 9 1 3				19913
3 6 2 6				4978	1 9 1 0				24454
3 6 2 3				5531	1 6 1 6				19360
3 6 2 0				6222	1 6 1 3				23232
3 6 1 9				7111	1 6 1 0				29040
3 6 1 6				8297	1 3 1 3				27878
3 6 1 3				9556	1 0 1 0				43560

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0 020 573 716 9